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EARLY FOREST CONDITIONS in the ALASKA INTERIOR

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an historical account with original sources

H. J. LUTZ

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FOREWORD

This report is based almost wholly upon the journals, records, and publications of early observations of forest conditions in Alaska's interior. The observers generally had no special training in forest description or in matters pertaining to the productivity, growth, and yield of forests or stands of trees. They included explorers, geologists, army and navy officers, and a few natural scientists. Their observations on forest conditions were often incidental to other more central objectives and the care and accuracy used in arriving at their estimates and measurements can only be conjectured. Consequently, at least normal caution should be used when comparing present-day forests and stands with those described by the early writers. The historical record of early forest conditions in the Alaska interior, compiled from the original sources, is presented. The question, "What were the forest conditions in the early days?" has been answered as best it can.

H. J. L.

CONTENTS

	Page
Introduction	1
General View of the Alaska Interior Forests	3
Copper River	7
Cook Inlet-Susitna River-Matanuska River	9
Lake Iliamna-Nushagak River-Mulchatna River	12
Kuskokwim River	14
Tanana River	18
Upper Yukon River	25
Lower Yukon River	36
Seward Peninsula-Kobuk River-Noatak River	41
Koyukuk River	52
Summary	55
References cited	58

EARLY FOREST CONDITIONS IN THE ALASKA INTERIOR

an historical account with original sources

By H. J. Lutz [1/]

INTRODUCTION

The natural forest cover in any region represents a stage of ecological development in time. It is never static. The forest of the present is not the forest of the past nor is it the forest of the future. However, both the present and the future bear the imprint of the past. It seems safe to say that anything approaching a satisfactory understanding of the contemporary forest requires appreciation of its history.

Knowledge concerning the "early" or "original" forest has interest beyond the purely intellectual or scientific. It affords a basis for judging the natural potentialities--and limitations--in an ecosystem where disturbances, although certainly not absent, were less general and less profound than in modern time. This knowledge provides evidence as to what the land could and did produce. It also provides a background for better understanding of the contemporary biocenose and physical environment; it furnishes a basis for judging the extent of the change resulting from man's activities.

An attempt was made to seek out and bring together all available information on early forest conditions in the Alaska interior. The terminal date generally adopted was 1912, but a few later observations have also been included. Search of the literature, begun in 1949, was facilitated by three major bibliographic aids:

1. "Partial list of books, pamphlets, papers in serial journals, and other publications on Alaska and adjacent regions," by W. H. Dall and Marcus Baker, in Pacific Coast Pilot, coasts and islands of Alaska, Second series, U. S. Coast and Geodetic Survey, pp. 225-375. 1879.

2. "A bibliography of Alaskan literature, 1724-1924," by James Wickersham, 1927.

1/ The author is Professor of Silviculture, School of Forestry, Yale University, New Haven, Connecticut, and formerly a staff member of the Northern Forest Experiment Station while engaged in several special investigations.

3. "Arctic bibliography," prepared for and in cooperation with the Department of Defense under the direction of the Arctic Institute of North America, first publication in 1953.

Information on early forest conditions in the Alaska interior is for the most part fragmentary, much of it consisting of incidental observations made by explorers and travelers. Up to 1867, under the Russian regime, interest was concentrated on furs, primarily the sea otter and fur seal. Activity was pretty well restricted to the coastal areas and there was little concern with exploration of the interior. In fact, neither the lure of fur bearing land animals nor gold was sufficient to cause the Russian-American Company to operate very far inland. Okun (1951, p. 58) 2/ stated that a report of the Company made in 1819 indicated that the hunting of sables and wolverines was of little importance because the hunters did not go far inland for fear of the natives. Okun (p. 245) also observed that, although officers of the Russian-American Company knew of the presence of gold in Alaska as early as the middle of the nineteenth century, they feared that these reports might arouse the government to take away the Company monopoly. Consequently, the Company opposed, by every means possible, surveys and exploration of their territory. Golowin (1863) remarked that the explorations undertaken by the Russians in Alaska were extremely superficial and confined almost wholly to the coast. He stated in 1863 that not only were the interior continental regions unexplored but that this was true even of Baranof Island (then called Sitka Island)! After purchase of Alaska by the United States in 1867, exploration of the interior regions continued to lag, and it was not until near the close of the century that a great stimulus to exploration and travel was provided by discovery, in 1896, of placer gold in the Klondike area, Yukon Territory. Unfortunately, most of the miners who stampeded to the gold fields of Alaska in the years that followed left no written records of the country.

The earliest accounts generally concerned conditions observed along the major rivers for these represented the easiest avenues of access to a remote land in which overland travel was difficult. This fact needs to be borne in mind for the forest fringe seen along the river banks often was not characteristic of the forest some distance back. In regions where permanently frozen ground occurs, forest growth along waterways is usually superior to that found on flat or rolling land where permafrost is present at shallow depth. Pelletier (1908, p. 134), an Inspector of the Royal Northwest Mounted Police of Canada, recognized this fact when he wrote: "All along the Churchill fair-sized timber is to be had anywhere. One can hardly conceive the state of barrenness of the inland when one follows the well-timbered and sheltered valley of the Churchill River."

2/ Names and dates in parentheses refer to Literature Cited p.

Present estimates indicate that nearly 120 million acres in the Alaska interior bear sufficient tree growth to warrant designation as forest land. Ecological conditions within this vast area differ greatly so it has seemed desirable for present purposes to divide Alaska into geographic provinces and treat each separately. Provinces recognized, and shown on the accompanying outline map (fig. 1) are, for the most part, drainage basins of major rivers. The following divisions, arranged roughly from south to north, have been employed.

A. Copper River

B. Cook Inlet - Susitna River - Matanuska River

C. Lake Iliamna - Nushagak River - Mulchatna River

D. Kuskokwim River

E. Tanana River

F. Upper Yukon River

G. Lower Yukon River

H. Seward Peninsula - Kobuk River - Noatak River

I. Koyukuk River

To locate topographic features and places mentioned in the text, large scale maps such as those prepared by the United States Geological Survey are recommended. The State of Alaska is so large that it is not practicable to include such maps in this report.

GENERAL VIEW OF THE ALASKA INTERIOR FORESTS

The literature contains various general statements as to early forest conditions in the Alaska interior as a whole. The fact that these statements represent very broad generalizations relative to the forest in a vast region having wide variations in physical environment needs to be kept in mind. It may not be unfair to suggest that some, at least, of the generalizations reflect a first-hand unfamiliarity with both the region and the forests.

In 1856 Roche wrote (p. 266) that "A great portion of this vast region [Russian America] (in some places to within a short distance of the Arctic Circle), is covered with forests of the largest and most valuable trees." Buynitzky (1868) thought that most of the native tribes of interior Alaska lived in "...primeval forests of such thickness that the only ways of communication are rivers...." Even Dall wrote in 1869 that "The country, excepting on the extreme sea coast, is heavily timbered with spruce, poplar (2 sp.), birch (2 sp.), willow (? sp.), alder, and larch." In his report published as part of the tenth census of the United States, Petroff (1884) stated that (p. 75) "...timber extends in good size as far north as the Yukon valley, clothing all the hills within that extensive region and to the north of Cook's Inlet and Kenai Peninsula...."

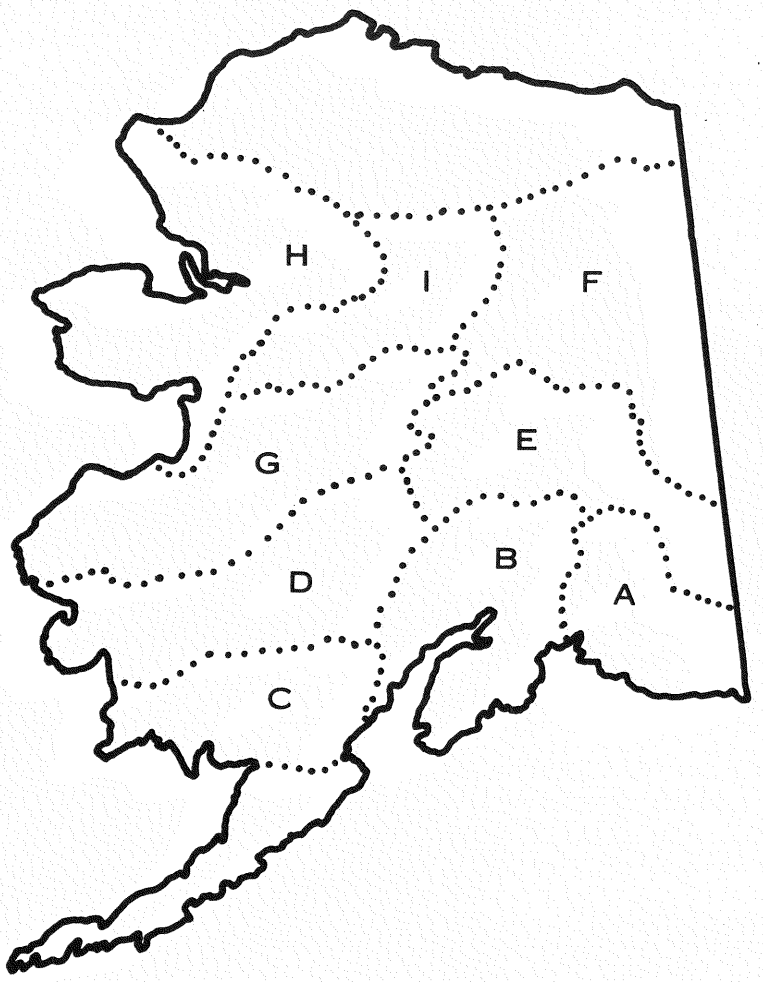

Figure 1.--Outline map of a part of Alaska, showing the geographic provinces used in this publication. A. Copper River; B. Cook Inlet-Susitna River-Matanuska River; C. Lake Iliamna-Nushagak River-Mulchatna River; D. Kuskokwim River; E. Tanana River; F. Upper Yukon River; G. Lower Yukon River; H. Seward Peninsula-Kobuk River-Noatak River; I. Koyukuk River.

The report of the Governor of Alaska for 1887 contains an account of an interview between the Governor and the son of a Yukon chief (Swineford 1887, p. 46). Asked, "How big do the trees grow up there?" the native answered, "Trees grow just like they do here, but they are of a different kind; some are small and some are large; they grow large in some places, in others small; they are pine and birch trees." As a generalization this is not bad, needing only the substitution of spruce for pine.

More explicit is the statement of Nelson (1887, p. 32):

> The district lies almost wholly within the drainage basin of the Yukon and Kuskoquim Rivers, except its northern portion, which is drained into Kotzebue Sound and the Arctic by several small rivers. The greater portion of this region is covered with trees, but numerous tracts of open tundra and marshy plains like those near the seacoast are found throughout its extent, and under much of it is a substratum of permanently frozen earth. This latter is less widespread and deep than it is on the coast. The white spruce (Abies alba) is the most abundant tree, becoming dwarfed near the coast and at a few hundred feet elevation, but along the course of the Yukon it sometimes attains a height of 100 feet, and measures 3 feet at the butt. It is ordinarily about one-half this size or less. The birch (Betula glandulosa) reaches from 30 to 50 feet in height, and is sometimes 2 feet in diameter, but is usually very much smaller. The poplars (Populus balsimifera and P. tremuloides) are abundant in the lower parts of the river valleys, and the former species is particularly common on the sandy islands in the rivers.

This probably represents the best general statement on early forest conditions in the Alaska interior; it has the substantial merit of being based on the personal observations of a scientist.

In the general introduction to the "Compilation of narratives of explorations in Alaska" an unidentified writer (Anon. 1900) commented on the Interior forest as follows (p. 12):

> Passing through the Coast Range into the Interior, we find a lesser growth, reported as a species of Norway spruce. This tree attains a growth of from 15 to 18 inches in diameter, while in favored localities may be found trees of far greater magnitude. Passing through central Alaska to the main range of mountains, we find that the cottonwood and birch are much in evidence, the former attaining a diameter averaging from 18 to 24 inches, while the latter will probably average from 14 to 16 inches. Passing through this range of mountains into the Yukon Valley, the growth of the timber shows the severity of the climate. Crossing the Yukon Valley, this feature becomes more marked until, passing into the Arctic Circle, the timber of the north is reached.

Fernow (1901) and Gannett (1901), both members of the Harriman Alaska Expedition, remarked on the Interior forest although neither of them had opportunity to inspect it. Fernow's interpretation of the meager accounts known to him was that "...the interior is in general an open plateau, hill and mountain country, mostly moss-covered and devoid of trees; but with scattered more or less open groves on the lower hill slopes and ridges, and in some of the valleys..., the trees usually crowding together more densely along the banks of rivers and lakes and covering with dense thickets many

islands in the rivers." Fernow thought that although the trees were "...mostly short, poorly developed, dwarfed, and standing in open positions, in consequence of which the timber is knotty and checked by frost, these groves occasionally assume a real forest character and contain trees developed to good size." (p. 240) A quite different view of the forest was expressed by Gannett (p. 273) who wrote that "The interior of the territory is forested, mainly with spruce, as far north as the valley of the Koyukuk, and as far westward as the delta of the Yukon. In this enormous region there must be a very large amount of coniferous timber, sufficient to supply our country for half a generation in case our other supplies become exhausted." Fernow regarded the language used by Gannett in describing the Interior forest as quite misleading and in 1902 published a statement criticizing Gannett. If the view of Gannett was too optimistic, that of Fernow was too pessimistic.

In the report of the Governor of the District of Alaska for 1902, Brady (p. 34) observed that "The timber along the rivers in the interior of Alaska is not subject to the same conditions as in the southeast section. For the most part it is spruce and does not grow large, rarely attaining a diameter of 2 feet. It is often found in compact masses."

Kellogg (1910) observed forest conditions in the Alaska interior during the summer of 1909. He reported that the forest was

> ...chiefly of the woodland type.... The best timber of spruce, birch, and poplar grows in the valleys of the streams, particularly along the Tanana, and excellent stands of birch and aspen are found also on the easterly and southerly slopes of creeks which have a silt soil. This is particularly true in the Fairbanks district. Black spruce predominates in the more poorly drained situations. Here, as farther south, it is characteristically a swamp and muskeg tree, though in some places abundant on hill and mountain slopes. Tamarack grows sparsely in river and creek valleys, but is nowhere of particular importance. The stand in the interior forest varies from practically nothing in areas of scrubby black spruce to 20 or more cords per acre in the birch-aspen type, and several thousand board feet per acre in the best white spruce forest. The average of the timber is small throughout; white spruce rarely and balsam poplar sometimes attain diameters of from 18 to 24 inches. The average diameter in white birch and aspen stands is about 8 inches, though maximums of 18 inches on unusually favorable sites were noted for these species. Black spruce rarely attains a diameter of 6 inches, and the less abundant tamarack is even smaller. The best white spruce trees are about 75 feet high. Birch, aspen, and poplar usually reach a height of about 50 feet; black spruce rarely more than 40 feet, many times not exceeding 20 feet, and tamarack seldom more than 30 feet.

Although the observations of both Nelson and Kellogg were quite limited in geographic extent, their impressions of the forest were similar and may be accepted as fairly portraying general conditions of their time.

COPPER RIVER

The earliest reference to the forest in the Copper River basin seems to be that of Grewingk (1850). He mentioned the existence of a cabin or hut, used by a Russian trader, on the bank of the Copper River near the mouth of the Chitina River (called the Tschetschitna). Grewingk stated that from the trader's cabin downstream to the mouth the banks of the Copper River were covered with fir, poplar, willows, and birch. The "fir" (Tannen) was unquestionably spruce.

Allen (1887), who traveled up the Copper River in 1885, remarked on the forest growth at three different localities--in the vicinity of Taral (p. 49), on the north bank of the Chitina River about 8 miles above the mouth of the Chitistone River (p. 52), and just below the mouth of the Slana River (p. 66). In each instance he referred to the growth as "dwarf spruce." Quite probably the trees were black spruce.

In 1898 the U. S. Geological Survey conducted a reconnaissance of part of the Copper River district. Schrader (1900, p. 370) reported that "In the Copper River district the country is comparatively well, though not densely, timbered. Spruce is the dominant and most valuable tree, and has a good tall growth.... The timber line scarcely reaches to 2,000 feet."

Lieutenant Walter C. Babcock, Eighth U. S. Cavalry, was a member of the Copper River exploring expedition in 1899. He wrote (p. 78) that "Its /Bernard Creek, tributary to Tonsina River from the southeast/ lower half is between high-cut banks, broken at frequent intervals by deep ravines. Along its banks and along the Tonsina near its mouth grow the largest spruce trees, 100 feet or more high and measuring 3 feet and over in diameter at the base."

Griffiths (1900) reported that "The country along the Slahna River, and for 10 miles west of it, is well timbered with spruce and a few smaller varieties." Rice (1900) regarded the timber along the Slahna River as "...exceptionally heavy, consisting of spruce, birch and cottonwood." Later on in his report he stated that "The white birch predominates in the vicinity of the Slahna, and will average about 14 inches in diameter." Glenn (1900) noted that "After passing the head of the Matanuska River, and up to the foothills of the Alaskan range of mountains, the trees are much smaller. In fact they are quite scrubby. In the valley of the Chestochena we found some large fir and spruce trees that would make excellent lumber."

In 1899 the U. S. Geological Survey carried out a reconnaissance of the Chitina River and Skolai Mountain regions in the Copper River basin. Rohn (1900, p. 414) observed that in the Chitina and Copper River basins timberline was between 3,000 and 3,500 feet but, on the upper Copper River, nearly 4,500 feet. He wrote that "The interior basins are well timbered except where burned over by the natives." Rohn reported that

> In places fine timber is found. As a rule, however, especially at the higher altitudes, it is rather short and somewhat scrubby. The only timber of importance is spruce. Several kinds of poplar are found and the trees sometimes attain considerable size. They grow chiefly on old gravel bars and river bottoms. At higher elevations birch is occasionally found, but it is usually small and of little value. Willow and alder, usually as brush, though sometimes attaining a size that entitles them to be classed with trees, predominate along the upper margin of the timber belt.

Schrader and Spencer (1901) remarked on forest conditions in the Copper River basin as follows (p. 92): "In swampy places the spruce is found to be small; but where the drainage is good, along river bottoms and on the side hills, the trees frequently reach a diameter of 3 feet, or even more, and would furnish good saw logs. Timber line is usually located in the vicinity of 3,000 feet elevation, but locally the trees extend from 300 to 500 feet higher."

Moffit and Maddren (1909) reported on the mineral resources of the Kotsina-Chitina region, Alaska, and included information on the forest vegetation. The Chitina River is a main tributary to the Copper River from the east, and the Kotsina River, also tributary to the Copper from the east, is just above the Chitina. They stated (p. 18) that

> Chitina Valley is a timbered region and furnishes a supply of wood suitable for most of the miner's requirements. The greater part of the timber is spruce but cottonwood is abundant on many river banks and deltas and, though it is of little value for lumber, it is nevertheless useful for some purposes. The broad, marshy valley lowland supports a scanty growth of very inferior spruce and aspen. Better timber grows along the borders of the lowland and on the lower mountain slopes. It covers the slopes to an elevation varying from 2,000 to 3,000 feet above sea level, but the trees growing near timber line are, of course, dwarfed and of little use except for firewood. Near glaciers or in the narrow valleys leading to them the timber line does not reach as great an elevation as on the interstream slopes. Some of the best timber in the valley grows in the vicinity of Chititu and Young creeks [both tributary to the Nizina River, from the south; the Nizina is tributary to the Chitina]. Trees 18 inches in diameter at the butt and tall enough to

> give two 16-foot cuts are not unusual, but the large majority of them are smaller than this. South of Chitina River between Nizina River and the Copper there is a heavy growth of spruce on the north slopes of the mountains. It is of much poorer quality, however, than that on the Wrangell Mountains. The wood is brittle and has little strength. Most of the trees, too, are of small diameter and will probably be of more value for the steamboat Chitina than for any other purpose.

From the foregoing statements it may be inferred that the Copper River basin was, in early time, fairly well forested. Timber line varied from 2,000 to 3,000 feet elevation above sea level and, in places, may have reached considerably higher. Burned areas were in evidence. Spruce was the dominant tree but there was some birch, usually small, on the uplands. Balsam poplar occurred on alluvial deposits along the rivers and attained considerable size. The better forest occurred along the streams, around the borders of the lowlands, and on the lower mountain slopes. The broad valley lowlands supported poor stands of spruce, as also did north-facing slopes; presumably the species was black spruce.

In the most favorable situations white spruce trees occasionally attained diameters around 36 inches and heights around 100 feet but, in most stands, diameters and heights were much smaller. Spruce around 18 inches in diameter were not unusual but most of the trees were smaller.

COOK INLET - SUSITNA RIVER - MATANUSKA RIVER

An observation by Wrangell furnishes one of the earliest references to the forests of Cook Inlet. He stated (Grewingk 1850, p. 39) that the coast from Anchor Point, at the north side of Kachemak Bay, to Kenai (then called redoubt St. Nicholas, established in 1791) was here and there covered by fir forest (Tannenwald). The evergreen trees seen by Wrangell were, of course, spruce and not fir. Then, as now, the forest was not continuous. Davidson (1868, p. 235) thought that "The western shores of Kenay peninsula are well wooded...."

In 1900 Wilfred H. Osgood, an assistant in the U. S. Biological Survey, spent about two weeks on the Kenai Peninsula in the vicinity of Hope, and another two weeks at Tyonek, on the northwest shore of Cook Inlet. Osgood (1901, p. 59) placed timber line on the Kenai Peninsula at between 2,000 and 3,000 feet elevation. He remarked (p. 60) that "Taken as a whole, the plant and animal life of Cook Inlet is very similar to that of the Yukon Valley or, in more general terms, to that of the interior of Alaska."

Kelly (1900) traveled down Eagle River (then called the Yukla-hitna or Yukla), tributary to Knik Arm, in 1898 and referred to the valley as well timbered with spruce and birch.

W. A. Dickey, a prospector, was in the Susitna River valley in 1896. It was he who named Mount McKinley, publishing an account of it in the New York Sun on January 24, 1897. In a reprint (Dickey 1951) reference was made to a view from a mountain some hundred miles above the trading station on the Susitna River, "...a broad, flat valley extending westward as far as the eye could reach, heavily timbered with spruce and birch. It is apparently a continuation of the flat country that surrounds the upper part of Cooks Inlet."

Learnard (1900) described the building of a boat at the mouth of Deshka River (then called Croto Creek), tributary to the Susitna River from the north, about 35 miles above the mouth of the Susitna. There they experienced no difficulty in finding a tree "...which could furnish lumber sufficient to build a boat 35 feet long and 5 feet wide at the bottom." From the spruce tree selected "...ten planks were sawed which were 35 feet long and averaged 11 inches in width. Many other trees were seen fully as large as the one cut for the boat. The finest timber seen in the Sushitna Valley was found in the vicinity of Croto Creek." On the Talkeetna River, tributary to the Susitna from the east, Learnard observed timber line at an altitude of about 2,500 feet. He stated that "The birch seen along the Sushitna River was usually very small, trees seldom being seen that were 15 inches in diameter." The birch made an unfavorable impression on Learnard for he characterized it as "...knotty, gnarly, and stunted."

The valley of the Talkeetna River impressed Griffiths (1900) as being heavily timbered with spruce. Along the Susitna River and its tributaries Griffith "...found some very good timber of the same varieties as those growing near the coast." He also observed that "The swampy area lying north and east of the Sushitna River is covered with a growth of timber which is quite scattering in places, while at others it is very thick. This timber has little value except for fuel, it being mostly small and scrubby, and many of the trees being dead, or partially so."

On the upper Susitna River, according to Thomas (1900),

> Spruce ran all the way from a few feet to 80 feet in height. Most of that which we saw was from 20 to 40 feet high and of small diameter; rarely did we see a tree of 20 inches in diameter; probably 9 inches was the average. Occasionally we would see a cottonwood from 3 to 6 feet in diameter, but most of them were small or of medium size; probably 16 inches was the average. The birches were all small or of medium size.

Eldridge (1900) stated that the valley of the Susitna River was "...generally well timbered with cottonwood, spruce, and birch, the latter upon the ridges and elevated portions." He also mentioned the Chulitna River valley as being well timbered. Eldridge reported that, in the Alaska Range, timber line occurred at approximately 3,000 feet.

In 1898 Spurr ascended the Susitna, the Yentna and the Skwentna Rivers. He reported (Spurr 1900) that

> All along the river bottoms, which on the lower part of the Sushitna are very wide, there is an abundant growth of timber consisting, in those flats which are near the level of the river, of poplar and willow, while the higher flats a little farther back from the river have abundant spruce and birch, both of considerable size. This timbering was found all the way up the river nearly to the pass.

Spurr also observed broad flats devoid of trees. Timber line above the main valley of the Skwentna was placed at 2,500 feet. Hinckley (1900), who accompanied Spurr, characterized the spruce and birch forest on the rolling plain back from the river banks as open, "...all through which a long grass, similar to our redtop, grew sparingly. Wherever the ground was poorly drained the trees and grass were replaced by moss."

Brooks (1911, p. 17) reported heavy timber consisting of birch, cottonwood, and spruce up to 2 feet in diameter on the lower slopes (up to about 1,000 feet) of Mount Susitna, about 15 miles northwest of the mouth of the Susitna River. Northerly from the Skwentna River, Brooks encountered "...a flat, heavily timbered region where almost continual trail chopping was necessary." He stated (p. 203) that

> The floor of the valley [Skwentna] is clothed with a heavy growth of timber. Poplars and birches predominate, but there is also some spruce. The largest trees measure 2 to 2-1/2 feet in diameter.... Near the Kichatna [a large branch of the Yentna River from the west, 10 miles above the Skwentna], however, the timber is more abundant, and here the poplars are of especially large size.

Brooks (p. 206) regarded the basins of the Susitna and Matanuska Rivers as "...fairly well timbered up to an altitude of 1,500 to 1,800 feet, and there is a sparse growth of stunted trees up to an altitude of 2,000 to 2,200 feet. In these districts the spruce, which furnishes the best timber, is usually less than a foot in diameter, though an occasional tree is found 15 to 18 inches in diameter."

Mendenhall (1900) traveled through the Matanuska River valley in 1898 and reported that the largest trees seen were cottonwoods in the lower part of the valley. They "...would not measure more than 4 feet through at the butt, and taper rapidly to an average of much less than this." Mendenhall placed timber line at 2,500 feet in the middle Matanuska valley and at 3,000 feet near the head. Martin (1906) was of the opinion that the timber in the Matanuska valley was similar to that on the flats at the head of Cook Inlet. He placed timberline at about 2,800 feet. In his view, "The spruce is considered of good quality, though small. Some of it will square 12 inches, considerable of it 8 inches, and most of it 6 inches."

Martin and Katz (1912) placed timber line in the lower Matanuska valley at around 2,000 to 2,500 feet. They indicated that the forest growth was, in general, not dense and that most spruce trees were under 12 inches in diameter; the largest spruce seen was 19 inches in diameter.

From the early records it appears that the Cook Inlet-Susitna River-Matanuska River region was in part well timbered. The best stands occurred in situations of relatively good drainage--along the streams and on the slopes and rolling uplands. Poorly drained flat land was practically devoid of trees or bore poor, open stands of spruce. Timber line varied from about 1,500 to 3,000 feet. Most of the white spruce was small, the dominants averaging around 10 inches or a little less. Occasional larger spruce trees, up to 20 and even 30 inches in diameter, were found but they were uncommon enough to be objects of special note. Maximum heights of 80 feet were observed but most of the spruce did not approach this. No information was obtained on age relations. The balsam poplar, Populus balsamifera, was the largest tree in the region and reached its best development along the larger streams. Black cottonwood, Populus trichocarpa, occurs on the Kenai Peninsula occasionally but is either lacking or rare in the Susitna and Matanuska basins. Occasional poplars 3 to 6 feet in diameter were reported but most of the stands contained trees much smaller. Information on the size of the paper birch is scanty but it appears that most of it was small.

LAKE ILIAMNA - NUSHAGAK RIVER - MULCHATNA RIVER

Schanz (1893) prepared a report on the Nushagak District for the Eleventh Census of 1890. He believed that the "...interruption of the coast line by rocky capes necessarily reduces the width and extent of the tundra strip to a minimum...whereas at the mouths of the Yukon and Kuskokwim the tundra extends several hundreds of miles inland before anything deserving the name of forest is seen." Schanz reported that "...there is a needlewood forest on the Nushagak river within 5 miles of Fort Alexander [an old name for the village of Nushagak, at the mouth of the Nushagak River]." He continued:

> The so-called Wood river, which is the outlet of the Alegnagik lake system [draining into Nushagak Bay], has very fine timber forests not more than 15 miles from Nushagak bay, and all firewood as well as building logs are brought from them to the trading post, the missions, and the salmon canneries on the bay. The whole Nushagak, or better Tahlekuk river valley, including Tikchik river and lake [on old maps called Nushagak Lake], is densely wooded with trees not more than a foot in diameter, until the distance from the coast and intervening natural obstacles protect the vegetation from the blighting ice-laden Siberian storms which, though not so low in temperature as the interior blizzards, are yet by far more dangerous, on account of their humidity, to animal and vegetable life. Then the diameter of the trees and the density of the primeval forest increase rapidly, so that on the Mulchutna [Mulchatna] and the Kokhtuli (Forest) rivers exceptionally large trees may be found in number. On my last winter's exploring journey I measured in a Kokhtuli spruce grove 9 trees, each of which was over 3 feet in diameter.

Schanz (1891a) traveled on the Nushagak River during the winter of 1890-1891 and in the native village of Kakwok (Kakuak), about 60 miles above the mouth of the river, he saw evidence of relatively large timber in the region. He wrote: "The kassigima [usually written kashim, a native community house] where we slept in Kakwok is exceptionally large, and is noted for its huge side planks, which are about five inches thick, three feet broad, and fifty feet in length, and which reminded me of the celebrated planks of Oogavigamute on the Kuskokvim." These planks must have come from either white spruce or balsam poplar trees, the two species attaining largest size in the region. After reaching the Mulchatna River, a tributary to the Nushagak, Schanz ascended it. He recorded that "The forest now became more extensive and dense, but great swaths had been cut through the timber by the fall hurricanes, while at the river's edge the spring ice-gorges had felled acres of forest-giants." (Schanz 1891b).

In 1902 Osgood made a biological reconnaissance of the base of the Alaska Peninsula. He reported, "A good growth of timber surrounds the entire lake [Clark] and runs up the mountain sides from 500 to about 1,500 feet." (Osgood 1904, p. 13). On the Chulitna River, which drains into Lake Clark, "Particularly fine clumps of white spruce were encountered along this part of the route; several trees were measured and found to be from 5 to 6 feet in circumference [19 to 22 inches diameter]. Others noticed in passing were evidently somewhat larger than these." (Osgood 1904, p. 15). Writing of a view from Portage Mountain, on the divide between the drainage to Lake Clark via the Chulitna River and the drainage to the Nushagak River, Osgood observed that "From this elevated viewpoint one fully appreciates how closely the heavier growth of coniferous trees is confined to the banks of the streams. Although the water itself is only occasionally seen, both the Chulitna and Kakhtul can be traced as far as the eye can distinguish by the lines of dark green spruce along their banks." This situation is common throughout the Alaska interior.

Greely (1909, p. 51) wrote that "In the lake region between Cook Inlet and Bristol Bay there are well-timbered areas with considerable large spruce, some said to be over three feet in diameter." It seems probable that Greely obtained his information from Schanz or Osgood.

It is evident from the early accounts that forest stands containing spruce trees at least as large as three feet d.b.h. were occasionally found in the Lake Iliamna - Nushagak River - Mulchatna River region. Such stands were, however, not general but restricted to situations of relatively good drainage--along streams and lake shores. Tundra occurred as a coastal strip but, in this region, was much narrower than to the northward in the Kuskokwim and Lower Yukon River sections.

KUSKOKWIM RIVER

The earliest reference to forest conditions in the Kuskokwim River region appears to be that of Vrangel' (1839, p. 126). He stated that Wassiljew (probably the Russian naval officer Captain Lieutenant Mikhail Nikolaievich Vasilief) described the Kuskokwim River from the junction of the Holitna River (called by him the Chulitna) to a point some miles upstream as supporting dense forests of larch, firs, poplar and birch. I infer that the observations of Vasilief were made in the year 1821; the firs (Tannen) were without doubt white and black spruce. The views of Vrangel' were quoted by Galitzin (1853, p.214).

Zagoskin (1847, vol. 85: 134; 1848-1849, vol. 2: 101; 1849, p. 450) made the following entry in his diary on May 29, 1844:

> The Ttychannanika [Upper Kuskokwim] River opposite the summer settlements [perhaps about 20 miles below the present village of McGrath] does not exceed 420 feet in width; the tundra on the right river bank is bestrewn with small lakelets; on the low hillocks are scattered larch trees up to 8 inches in diameter; these are the largest larch trees we have observed in the entire country that we have visited.

Galitzin (1850, p. 259) commented on the driftwood of trees, none of them large, continually carried down by the Kuskokwim River. He concluded that no forests of importance existed on the upper reaches of the river.

Elliott (1886, p. 406) wrote of conditions in the vicinity of the old Russian trading post of Kolmakof (called by him Kolmakovsky) on the north bank of the Kuskokwim River some 200 miles above its mouth. "Here the current of the stream has narrowed, and flows between high banks over a gravelly bed. These terraces, which rise from the water, are flat-topped, and covered with a tall growth of spruce. Mossy tundras and grassy meadows roll in between forest patches. The timber is much larger here than it is anywhere else in the great Alaskan interior...."

Petroff (1891a) used expressions such as "very extensive forests" and "this almost inexhaustible timber supply" in describing the forest cover of the Kuskokwim and upper Yukon River valleys. He regarded the forest as "lining the water courses and clothing the rolling hills to an altitude of from 500 to 1,000 feet" (p. 39). In Petroff's view"...the great bulk of it, perhaps four-fifths of the whole, consists of the so-called Sitkan spruce, with a soft, spongy wood, and exceedingly knotty, as the trees limb from the ground up." Of course, Petroff was incorrect as to the identity of the spruce; Sitka spruce is a coastal species unknown in the Alaska interior.

Porter (1893, p. 105) in discussing affairs at the native village of Kikikhtagamiut, situated on the banks of a slough several miles from the Kuskokwim, noted that "The graceful, half decked birch-bark canoe is in general use, though to obtain the bark it is necessary to ascend to the upper reaches of the river, where birch forests of considerable extent exist." Petroff (1891b) also mentioned that the natives living on the banks of the Holitna River, principal southern tributary to the Kuskokwim, obtained material for their birch-bark canoes "...from the densely wooded banks of the middle course of the Kuskokwim."

The existence of at least occasional large trees on the middle or upper Kuskokwim is indicated by an observation of Porter (1893, p. 105). He wrote that "Each of the permanent villages on this part of the river [presumably referring to the general region of the Great Bend of the Kuskokwim near longitude 158°] has one or two large kashgas [kashims], built with logs of great size, for the accommodation of visitors and the performance of masked dances during their winter festivals." Schanz (1891a) described a large kashim on the Nushagak River which, in his words

> ...reminded me of the celebrated planks of Oogavigamute [Ugovik, a native village on the right bank of the Kuskokwim River, about 30 miles above Bethel] on the Kuskokvim. These noted boards were famed far and wide among the Innuits, and there is a 'yarn' still extant that the Oogavigs, during their internecine wars, carried these boards with them on their fighting expeditions, to use them as breastworks. Unfortunately, in the spring of 1890, before Greenfield and I visited Oogavigamute, the high water and the ice had carried away the great kassigima [kashim], planks and all.

Schanz (1893) included in his report a description by William C. Greenfield of the watershed between the Nushagak and Kuskokwim Rivers, as seen by Greenfield during a journey over the Holitna portage.

> For a distance of probably 90 miles by the river, the Holitnuk flows with a very sluggish current and remarkably crooked course through a very flat country, a narrow belt of timber just fringing the stream; the banks are very low and it is evident that in spring and early summer the country is overflowed. There are large stretches of flats on the lower Holitnuk covered with the most luxuriant growth of grass that I have ever seen in Alaska for extent and richness.

J. H. K. (1894) described a trip down the Kuskokwim River made by a friend in 1891 or 1892.

> My friend embarked with his two native companions only a short distance west of the source of the Kuskokwim, about nine hundred miles from its mouth in Bering Sea. In their entire progress they encountered neither falls nor wild rapids. For the first 350 miles both banks were lined with a dense forest of small pines, firs, hemlocks and cedars, none of the trees being more than a foot in diameter; a fact closely observed at all camping places while passing this scrub timber region. The valley is broad on either side, and back of it rise a range of hills covered with forests of a like kind, and still further back ranges of high mountains clad with this kind of timber until it meets the snow. After passing through this slightly timbered region for about 350 miles, they reached a section which stretched away to the mouth of the river, about 600 miles away, which was a continuous savannah.

The "pines, firs, hemlocks, and cedars" were quite certainly none of these species; rather they were the two spruces, black and white, and perhaps tamarack.

In 1898 Spurr crossed to the Kuskokwim from the Susitna basin and wrote that "...the valleys of the upper Kuskokwim were found to be covered by a good growth of spruce of considerable size, with birch, poplar, etc., entirely similar to the timber on the Sushitna side." (Spurr 1900). He continued:

> The growth of spruce is continuous along the river till below Kolmakof. Here is a remarkably sharp division line, where the thick spruce of the hills which line the river suddenly thins out, becomes very straggling, and in the course of a few miles disappears entirely leaving only barren moss-covered hills which stretch to the southward away from the river and run into the low, swampy, treeless plains known as tundra. From here down to its mouth the islands in the river and the flats bordering it have frequent groves of poplar, often of considerable size, but practically no spruce, while the tundra further away from the river is quite treeless, supporting only low shrubs, but covered with enormously luxuriant growth of moss.

Herron (1901) conducted an exploration in Alaska in 1899. He reported (p. 51) that "Spruce growing about 2 feet in diameter and about 100 feet high are common along the Tonzona, Chedotlothno /Chedotlothna/, Shissnona /Shisnona/, Hitzeecolochna /Hitzikolok/, Tatlathno /Tatlathna/, and upper Kuskokwim." Further on (pp. 56-57) Herron wrote that

> The timber of the upper Kuskokwim country is superior to that of any other part of Alaska observed by me. The largest timber is found on the river banks, where one to two feet diameter spruce is abundant, and in most cases situated where it can be rafted out. The Tonzona, Ecolena [Ecolina], Chedotlothno, Shissnona, Hitzecolochna, Tatlathno, and upper Kuskokwim are well timbered with large spruce.... Birch grows on the ridges and other drained ground and is used by the Indians for snowshoes, birch-bark canoes, bows and arrows, sleds, fish traps, bark baskets, and bark baby cradles.... Tamarack is met with in the upper Kuskokwim country. A tree supposed to be Balm of Gilead is occasionally found. Stunted spruce, about 15 or 20 feet high and a few inches in diameter, occupy the plateau of the upper Kuskokwim country. Large areas of these have been burned by grass and moss fires, leaving dead forests of charred trees. On the banks of the plateau streams, however, the timber is large and abundant.

The largest tamarack noted by Herron (p. 74) was 30 feet tall and about 8 inches in diameter. The balm of Gilead mentioned by Herron was without doubt the balsam poplar, Populus balsamifera L.

Brooks (1911, pp. 203-204) included in his report on the Mount McKinley region observations on forest conditions in the upper Kuskokwim River basin. He wrote that

> Beyond Rainy Pass the route led through a heavily wooded valley tributary to Dillinger River. Here the timber line is at about 2,800 to 2,900 feet, or 300 or 400 feet higher than on the coast side of the divide. The timber in this valley is chiefly spruce, but includes some poplar. Toward the Kuskokwim the timber gradually becomes larger, the spruce being 12 to 18 inches and the poplar 10 to 12 inches in diameter. The Kuskokwim Valley is well timbered with spruces and contains some scattering poplars. A few white birches were noted on the higher slopes of the valley.

Early travelers in the Kuskokwim River region found the best white spruce forest along the waterways and in other well drained situations. Trees 24 inches, or more, in diameter and as much as 100 feet in height were encountered but most of the trees were much smaller. Larch was occasionally encountered but the trees were small, not over about eight inches diameter. In the middle and upper course of the Kuskokwim, paper birch occurred on the ridges and fairly well drained slopes. Balsam poplar was found on the flood plains along the larger streams and on islands in the Kuskokwim River. Extensive tundra and black spruce muskeg areas were observed. The black spruce occurred on poorly drained situations where it may be presumed that permafrost was present at shallow depth. The position of timber line was variable but may have been around 2,800 to 2,900 feet elevation.

TANANA RIVER

The earliest indication as to forest conditions in the Tanana River region is found in the account of Dall (1869b) who remarked (p. 176) that "The unexplored waters of the Tananah River bring down the largest logs in the spring freshets." Dall makes nearly identical statements on pages 281 and 439 in his "Alaska and its resources," published in 1870. Dunham (1898, p. 381) almost certainly had Dall's observations in mind when he wrote, "The unexplored waters of the Tanana bring down the finest logs of this species [white spruce] in the spring freshets."

Henry T. Allen, in 1885, was the first white person to travel down the Tanana River and leave a record of his observations. In his report (Allen 1887) it was stated (p. 78) that "Spruce grew down to the very banks of the river." The section of the river being described was just below the mouth of Tetlin [Tetling of Allen] River. In the vicinity of the mouth of the Tok River [called Tokái by Allen] it was noted that "Most of the spruce timber growing along its [the Tanana] banks was from 3 to 8 inches in diameter." Allen also noted that "Nearly all the islands in this part of the river are timber covered." About five miles below the mouth of the Goodpastor River, Allen observed (p. 83) that "...the land near the river [Tanana] on both sides is flat, with a very limited quantity of timber, most of which is dwarf birch."

Glenn (1900, p. 643) traveled down the Delta River in 1898 and reported that "Throughout the entire valley of the Delta River trees were found suitable for lumber." He also recorded (p. 639) that "The valley of the Tanana River at the point where we saw it--the mouth of the Delta River--is from 20 to 30 miles wide. It was covered with a dense growth of timber of medium size, principally spruce, throughout which was a dense growth of moss." Mendenhall (1900, p. 336) was of the opinion that "The valley of Delta River contains much good spruce timber, but instead of covering the lowlands completely, as it does nearer the coast, it grows in clumps which alternate with prairie-like meadows, in which no trees are found."

A letter written by Captain P. H. Ray, Eighth Infantry, on September 15, 1897 and recorded in Alger (1899) contains the information (p. 14) that "I did not find any large timber in the immediate vicinity [mouth of the Tanana River], but excellent saw timber (spruce) can be found in great abundance from 5 to 10 miles up both the Yukon and Tananah, which will make the delivery at the post easier and cheaper than by hauling."

Pearson (1900) was with an exploring party in the upper Tanana basin in 1899. In his view, "The country is heavily timbered with spruce, cottonwood, birch, balm of gilead, and the quaking aspen. The spruce is of exceptionally good quality for the interior, trees of a diameter of 18 inches being very common.... Grass is abundant, generally of the redtop variety, and exists in patches of 40 acres or upward."

En route from Valdez to Eagle City in 1899, Rice (1900) observed forest conditions and noted (p. 786) that

> Once through this pass [Mentasta Pass] we soon reached the Little Tok, which was easily forded, and proceeded to the Big Tok. Arriving there, we were again compelled to build a raft to get our outfit across. In the valleys between the two rivers we encountered some of the heaviest timber we had yet seen on our travels. Some of the spruce and fir trees were over 2 feet in diameter and 90 to 100 feet in height.

Griffiths (1900) remarked that

> From the Delta River eastward, along the base of the Alaska Mountains, there is no timber except along the streams. These, however, are quite numerous and each is bordered by a narrow strip of timber, which is principally cottonwood, quaking aspen, and willow, the spruce being very scarce near the head of these streams. Looking down, however, it can be easily seen that within a few miles the spruce again predominates and grows thicker as the valley becomes lower.

Brooks (1900a) carried out a reconnaissance trip from Pyramid Harbor to Eagle City and characterized the Tanana River valley as "heavily wooded." He stated (p. 387) that "The Tanana is especially noted for its large trees, which are found up to 18 inches and 2 feet in diameter." In another report (Brooks 1900b, p. 489) one finds the statement that "Among the earliest mentions of the Tanana River we find statements in regard to the large trees which were found among the driftwood at its mouth." Brooks recognized that timber line varied according to local conditions but gave 3,400 feet as a general average.

Wells (1900, p. 516) thought that "The forest growth is also heavy in the Tanana Valley, although the trees will not average more than 10 or 12 inches diameter. Fairly good lumber can be produced. The growth is mostly northern spruce, with some birch, and willow interspersed."

In 1903 while traveling on the Tanana River, between the mouths of the Nenana and Kantishna Rivers, Wickersham (1938, p. 219) observed that "The valley of the Tanana is low, wide and heavily forested...." He thought the banks of the Kantishna River were "well timbered" (p. 220). On May 23, 1903 at Tuktawgana, an Indian village on the Kantishna, Wickersham noted that "The valley of the Kantishna is wide, and forested with a light growth of spruce and birch, while a denser growth of larger and better timber stretches along the sinuosities of the streams far up into the foothills." (pp. 238-239). Observations on the forest vegetation in the vicinity of Cleary and Pedro Creeks were recorded by Wickersham in April 1903. He wrote, "The lesser hills and wide valleys are everywhere covered with an evergreen forest of spruce, though on the lower southern slopes there are groves of birch...." (pp. 179-180).

Prindle (1904) made several observations on forest conditions in the Fairbanks district. He concluded, (p. 66), that

> There is very little timber large enough for mining purposes on the creeks, but a sufficient quantity is to be found a few miles away in the lower valleys of the larger streams and in the valley of the Tanana itself. Three sawmills are located at Fairbanks and have a total daily capacity of about 50,000 feet. The moss-covered surface of the highest divides gives place to that of dwarf birch and alder on the lower ridges, and the growth of small spruce on the slopes and stream bottoms is abruptly terminated by the willow-covered strip which follows the waterway. Along the upper slopes and spurs are scattering poplar and birch, which lower down cover the hillsides bounding the Tanana Valley. (p. 67)

Prindle reported that on Pedro Creek "The sides of the valley are clothed with a light growth of spruce, sufficient only for wood and cabin material." (p. 68). In his description of Fairbanks Creek, Prindle noted that "The spurs to the north are thickly covered with a growth of small spruce and some poplar. A very small proportion of the spruce is large enough to saw into 8-inch boards." (p. 71). Prindle (1905, p. 72) stated that "The slopes and portions of the valley of Cleary Creek are covered with a light growth of small spruce and some birch and poplar. In the valley of the Chatanika timber is more abundant and larger than in Cleary Creek Valley." In 1906 Prindle, writing of the Fairbanks region, observed (p. 112) that "The spruce timber along the sloughs of the Tanana and the lower parts of the valleys of its largest tributaries is of good quality and much of it exceeds 2 feet in diameter at the butt. The small spruce and birch so abundant on the hillsides furnish a supply of fuel which has not up to the present time been heavily taxed."

In a statement on July 23, 1903 to a Senate subcommittee at Rampart, Alaska, Hendricks (1904, p. 134) expressed the view that "The valley [Tanana] is well timbered. There are all the resources in the way of timber that are at all necessary for domestic use." The same subcommittee on July 22, 1903 heard Judge James Wickersham describe the Kantishna valley as "...a very rich region and covered with a beautiful growth of timber." (Wickersham, 1904, p. 120). Mitchell (1904, p. 59) testified before the subcommittee at Eagle, Alaska, on July 16, 1903. In characterizing forest conditions in the Tanana River valley from Tanana Crossing to Chena, Mitchell stated that "The timber along this section is composed of spruce, cottonwood, hemlock, birch, aspin [sic], and willows.... Some timber along this section is very large for Alaska, some trees being as large as 3 feet in diameter."

Cantwell (1904) reported the operations of the U. S. Revenue Steamer "Nunivak" on the Yukon River Station during 1899-1901. He described the difficulties that were encountered in obtaining 600,000 feet of sawlogs (with specification that they be 12 feet in length, and not less than 12 inches at the butt and 8 inches at the top) for use at the army post at Fort Gibbon, on the north bank of the Yukon River at the mouth of the Tanana. George Sharpe, a contractor who undertook to furnish the logs during the winter of 1900-1901, searched an extensive area along the Yukon River and failing to find sufficient timber along that waterway "...was compelled late in the season to go up the Tanana River a distance of about 80 miles from the mouth of that stream to find a suitable place to begin operations." (p. 118).

In 1906 Charles Sheldon observed forest conditions in the upper Kantishna River basin. "It [the Bearpaw River, a right or east branch of the Kantishna] flows through the vast level swampy country bordering the Kantishna River--a country well covered with timber and abounding in creeks and small lakes. Much tall spruce grows along the banks, and everywhere on both sides big white birches are scattered through the woods." (Sheldon 1930, p. 90).

Rickard (1909, p. 263) described the founding of Fairbanks in the following words: "Unable to proceed farther, Barnette [on the steamer "Lavelle Young"] and his expedition returned to the mouth of the Chena and worked their way up the slough to the place where Fairbanks now stands. The site was chosen by reason of the high bank, promising escape from floods, and an unusual growth of forest, including many spruce 24 to 30 inches in diameter. Here they landed on August 24, 1901."

Greely (1909, p. 51) employed what appears to be rather extravagant language in describing the forests of the Tanana. He wrote: "The Tanana Valley has almost inexhaustible supplies of poplar, spruce, hemlock, and birch, and in the lower valley considerable tamarack.... While there are enormous areas densely wooded in the Tanana Valley, yet the timber near the mining camps is rapidly disappearing." It may be observed that there is no hemlock in the Tanana valley and that only 9 years earlier the contractor, George Sharpe, had to ascend the Tanana River some 80 miles in order to find enough timber to piece out his contract for saw logs to be supplied to the army post at Fort Gibbon.

The dwindling supply of readily accessible timber in the Fairbanks district was indicated by the statement of Riggs (1910) that "After ten years of great mining activity around Fairbanks the wood available for fuel has been destroyed within the economic limits of wagon and sled haul and the mining industry is appreciably slackening." Riggs was referring to wood for fuel; the evidence is that saw timber supplies were even shorter.

The earliest fairly comprehensive report on forest conditions in the Alaska interior was made by Kellogg (1910) who obtained most of his information during the summer of 1909. He stated that

> The best timber of spruce, birch and poplar grows in the valleys of the streams, particularly along the Tanana, and excellent stands of birch and aspen are found also on the easterly and southerly slopes of creeks which have a silt soil. This is particularly true in the Fairbanks district. Black spruce predominates in the more poorly drained situations. Here, as farther south, it is characteristically a swamp and muskeg tree, though in some places abundant on hill and mountain slopes. Tamarack grows sparsely in rivers and creek valleys, but is nowhere of particular importance.

Kellogg made measurements and ring counts on 25 long logs of white spruce at a mill in Fairbanks. The logs were cut on the Chena River, about 75 miles above Fairbanks. They varied in length from 25.0 to 37.2 feet; in butt diameter from 14.7 to 19.0 inches; and in top diameter from 10.2 to 13.2 inches. Stump ages varied from 90 to 200 years and age at the top varied from 68 to 160 years. Average annual rate of height growth is indicated as 10 inches. Average rate of diameter growth at stump height (about 2 feet) was about 1 inch in 9 years. A smaller sample, consisting of 16 measurements and ring counts, was obtained on upper Isabella Creek, northeast of Fairbanks. White spruce having an average stump diameter of 18.4 inches (stump height 27 inches) showed an average age of 121 years; average rate of diameter growth at stump height was about 1 inch in 6.5 years. Diameter measurements and ring counts for birch bolts were also obtained by Kellogg but age values are uncertain because of the difficulty in distinguishing growth rings. The scarcity of accessible timber in the Fairbanks area at this early date is indicated by Kellogg's statement that "The logs for the Fairbanks mills are driven 75 to 150 miles from the Chena and Salchaket /Salcha/ rivers." At the time there were three sawmills in operation in Fairbanks and one at Chena, 9 miles distant. Two of the Fairbanks mills were reported to have a daily capacity of about 20,000 board feet each; the third was smaller.

Brooks (1911) described the country through which he passed while traveling toward Tortella, an Indian village on the south side of the Tanana River a short distance above the mouth of Cantwell River. "We followed this trail for 30 miles across the lowland of the Tanana. Broad meadows of magnificent grass alternated with belts of birch, cottonwood, and fine spruce, or with large marshes dotted with lakes. The timber was unusually large for the Yukon basin, trees 18 to 24 inches in diameter being not uncommon." (p. 20). Brooks' further account of forest conditions (pp. 204-205) is so informative that it is quoted at some length.

From the Yanert Fork of the Nenana the party crossed a high divide to the north and here found the timber line between 2,600 and 2,700 feet. In this area the piedmont plateau is only about 2,200 to 2,400 feet high and is covered with spruce. Where crossed by the party this plateau had been ravaged by forest fires many years before and was covered with a luxuriant growth of grass. From the upper margin of this plateau a good view was obtained across the Tanana Valley, which was found to be fairly well timbered though it is broken by meadows and swamps, together with some lakes and abandoned sloughs of drainage courses. On traversing this lowland it was found to be made up in part of spruce swamps, in part dry land covered with an open growth of poplars, white birch, and some spruce. Much of the lowland had previously been burnt over and was then covered with a second growth of timber 25 to 30 feet in height, interspersed with a fine growth of grass. The largest trees noted in the Tanana Valley were the white birches, some of which exceeded 2-1/2 feet in diameter. Spruce trees 18 inches to 2 feet in diameter are also not uncommon but are confined chiefly to the immediate banks of the larger streams. Here are also found extensive areas of tamarack or larch, the largest of which do not exceed 18 inches in diameter. This tree appears to be confined to the lower Tanana Valley, its tributaries, and the upper Kuskokwim. It is also sparingly found on the Yukon, near the mouth of the Tanana, and is reported by A. G. Maddren to occur on the Innoko River.

The timber in the flat drained by the Tolovana is similar in grade and variety to that of the Tanana Valley. On the better drained portions, the deciduous trees--poplar and white birch--predominate; in the wetter portions spruce is usually the most common tree. The courses of the many streams which traverse this lowland are outlined by growths of heavy timber along the banks. The trees are spruce, white birch, and some poplar, and many of them attain diameters of 18 inches to 2 feet; here and there one reaches 2-1/2 feet. Tamarack is also rather abundant on the flats.

Beyond the Tolovana flats the route lay across a portion of the Yukon-tanana upland and for the most part was below timber line, which is here at about 3,000 to 3,200 feet. As in other parts of the district, the chief trees are spruce, poplar, and white birches, the first two predominating.

Stuck (1914, p. 155) described his stay at the natural hot springs near Baker Creek [tributary to the Tanana] in the spring of 1906. "It was a beautiful and interesting spot then, with noble groves of birch and the finest grove of cottonwood trees in Alaska--all cut down now--all ruined in a plunging and bounding and quite unsuccessful attempt to make a 'Health Resort' of the place...."

Bennett and Rice (1919) made a soil reconnaissance in the Tanana valley in 1914. Although their observations were made at a date a little later than that generally employed as terminal in this account, inclusion seems justified.

> The greater part of the Tanana bottoms is timbered. Spruce, aspen, birch, and cottonwood constitute the important trees, with much willow and alder occurring in thickets and as an undergrowth. Spruce is the most abundant tree throughout the bottoms, dominating the more important forests and frequently growing to the exclusion of other trees. There are a few large timbered tracts in which this tree is not present. It varies in size from a very small tough scrub (black spruce), on wet peaty and mucky lands and on soil having ice near the surface, to trees 24 inches across the stump (white spruce) on well-drained sandy and silty soils. Much of it is of sufficient size for lumber and crossties. Birch is common on the silty soils of the entire bottoms. It appears to be most abundant and larger on the silt loam land near the foot of the uplands, where it attains a diameter of about 14 to 16 inches. Scrubby birch is likewise abundant on all the soils, especially those of imperfect drainage. Aspen is also widely distributed through the bottoms. It is most abundant on well-drained shallow soils overlying sand and gravel, and especially abundant on such lands as the gravelly soils along the Nenana River. This tree attains a diameter of about 16 inches on the heavier soils. Most of it, however, is found on the sandy soils and is of rather small size. Cottonwood is mainly confined to the sandy soils near the streams. There are many strips of forest composed almost exclusively of cottonwood (poplar) fringing the banks of the Tanana. The tree frequently grows to a diameter of 2 feet or more. Willow and alder are abundant in nearly all of the wet depressions; they are common as thickets and in scattering growth over most of the wet flats, and are quite numerous near the banks of streams. These constitute a common undergrowth even on the well-drained sands, where spruce is dense and of large size. (pp. 153-154)

From earliest time the Tanana valley was regarded as a region with relatively large timber; this opinion was based on the relatively large size of the driftwood logs carried down the Tanana River during flood periods. Early travelers in the Tanana basin encountered occasional white spruce trees as large as two to three feet in diameter with heights of 90 to 100 feet. These almost invariably occurred where drainage conditions were unusually favorable, as along streams. In general, the white spruce was much smaller, perhaps 10 to 12 inches in diameter. Much of the country was poorly drained and supported poor stands of black spruce. Treeless tundra areas were common as also were areas of grass that may have represented old burns. Timber line varied from place to place, but often was located at 2,500 to 3,500 feet elevation. Even at the beginning of the present century readily accessible spruce of sawtimber size along the major rivers was scarce. As early as the winter of 1900-1901 a contractor had to ascend the Tanana some 80 miles in order to find saw logs to fill a contract with the military post at Fort Gibbon.

UPPER YUKON RIVER

As a result of explorations by Chief Trader John Bell of the Hudson's Bay Company, it was decided to establish a post on the Yukon River near the mouth of the Porcupine River. The important task of establishing this new post was entrusted to Alexander H. Murray who left "Lapiers House" on June 11, 1847 and reached the Yukon on June 25. Murray's first impression of the Yukon was unfavorable; the following remarks reflect his opinion of the river immediately above the mouth of the Porcupine: "As far as we had come (2-1/4 miles) I never saw an uglier river, everywhere low banks, apparently lately overflowed, with lakes and swamps behind, the trees too small for building, the water abominably dirty and the current furious; but I was consoled with the hopes held out by our Indian informant that a short distance further on was higher land." (Murray 1910, p. 43). The site selected by Murray for the post of Fort Yukon was about three miles up the Yukon above the mouth of the Porcupine River. "The one chosen is decidedly the most eligible, the answers well only for the scarcity of timber; it is on a ridge of dry land extending about 300 yards parallel with the river, and 90 yards in width...." (Murray 1910, p. 44). Murray's account of the building of Fort Yukon in 1847 gives an insight into forest conditions of the region:

> The dwelling house and store was all the building that could be completed, and although it might sound to you, that little work was done for the time and number of hands, still if you saw it you would think otherwise. Had we squatted down in the first point of good timber, and begun a fort like some of your outposts, it might have been completed in the same time, but we are far from large timber, and building on a more extensive scale than usual, both house and store are substantial and well finished work.... The dwelling house is 46 x 26 feet containing five compartments--a hall in the centre, an office or sitting room and a bed room in one end, assistants room, and kitchen in the other. It is built of well squared 8-inch pine [spruce] logs, the partitions are also of squared and closely joined logs, ball proof, and as we had no pickets around in the first season, small loop holes were made on each side of the hall neatly fitted with blocks of wood which can be opened at pleasure from the rooms, and used for musketry in case the Indians should attempt to play us the same trick they did to Mr. Campbell and his party at Duses [Dease] Lake. (Murray 1910, p. 66)

> The store is only 40 feet in length at present, but an addition of 16 feet is to (be) made next season for a fish store, etc. The men's houses will be the same length 56 feet containing three rooms, one of which is intended for a carpenter's shop, etc. (Murray 1910, p. 66)

> A house or shed capable of containing two boats is to be erected at the end of the men's houses and a meat scaffold as at Fort Simpson at the end of the store. The pickets will not be pointed poles nor slabs, but good sized trees dispossessed of their bark and squared on two sides to fit closely and 14-1/2 feet in height above ground, 3 feet under ground, making a solid wall of 9 or 10 inches at the bottom and 6 or 7 inches at the top, secured together by being morticed into a solid frame along the top, and the same in the foundation. The bastions will be made as strong as possible, roomy and convenient. When all this is finished, the Russians may advance when they d----d please. (Murray 1910, p. 67)

> The dry land (and where it is dry it is dry, being of a sandy soil) is mostly open, or having a small birch and willows, the only wood of importance is along the banks of the river or on the islands. (Murray 1910, p. 79)

An entry in Murray's journal on June 16th, 1848 conveys the following information:

> Our spring operations are pretty well forwarded considering the great distance all the wood had to be brought. Two new boats are built, each 30 feet 8 in. keel and 9 feet beam. The cutting the timber for their boats and bringing the same in sleds from two to four miles distance was a tedious affair, but it is now over and with that built last spring, there are now three good boats, as many, I suppose as will be required for some time.... The pickets for the Fort are all cut and squared, and collected into piles close to the river, they also had to be got on the upper islands, as no trees large enough could be found more convenient, they are to be rafted down stream on my return, they are the strongest pickets in the country and when put up with bastions in proportion will have something the appearance of a Fort. (Murray 1910, pp. 98-99)

Bone (1867) made reference to timber conditions on the upper Yukon as observed by Ketchum during the summer of 1866; Ketchum was a member of Robert Kennicott's party, employed by the Western Union Telegraph Company.

> Not long afterwards Ketchum and his party returned to Fort St. Michael, having successfully made the passage to Fort Yukon and back. The country from Nulato eastward was found to be similar to that lower down the river, the banks varying in height, but most of the near elevations being on the northern side; the streams from the north were small, and those from the south much larger. The character of the timber improved, the spruce ranging from twenty-five to one hundred feet in height. (Bone 1867, pp. 742-743)

Sumner (1868, p. 166) wrote that

> On the Kwichpak and its affluent, the Youcon, trees are sometimes as high as a hundred feet.... Near Fort Youcon, at the junction of the Porcupine and Youcon, are forests of pine, poplar, willow, and birch. The pine is most plentiful; but the small islands in the great river are covered with poplar and willow. Immense trunks rolling under the fort show that there must be large trees nearer the headwaters.

Collins (1868, p. 27), in referring to observations by Major Robert Kennicott, stated that: "On the upper waters of the Kvichpak, and upon the whole course of the Youcan, timber is plentiful...."

Dall (1868) wrote that "Starting at Fort Youkon and going down stream we have on either hand, low land sparsely wooded with spruce, poplar, birch and willow, with low hills in the distance, gradually increasing in height and coming closer to the river, where they finally come together 225 miles below Fort Youkon."

An anonymous note (perhaps written by W. H. Dall) in the Mining and Scientific Press in 1868 stated that,

> As the traveler advances inland, particularly along the small rivers and up the valley of the Youkon, he soon comes to a very densely wooded country. The trees are of medium size, and are white spruce, willow, poplar, and birch, preponderating in the order named; the diameter ranging from eight inches to two and a half feet, a very common average being one and a half feet.

Writing of the Yukon River valley Dall (1869b; 1870) observed that:

> The largest and most valuable tree found in this district is the white spruce (Abies alba). This beautiful conifer is found over the whole country a short distance inland, but largest and most vigorous in the vicinity of running water. It attains not unfrequently the height of fifty to one hundred feet, with a diameter of over three feet near the butt; but the most common size is thirty or forty feet and twelve to eighteen inches at the butt.... These trees decrease in size, and grow more sparingly near Fort Yukon, but are still large enough for most purposes....
>
> The tree of next importance in the economy of the inhabitants is the birch (Betula glandulosa). This tree rarely grows over eighteen inches in diameter and forty feet high. On one occasion, however, I saw a water-worn log about fifteen feet long, quite decorticated, lying on the riverbank near Nuklukahyét [a village on the north bank of the Yukon River, just below the mouth of the Tanana] on the Upper Yukon; this log was twenty-four inches in diameter at one end and twenty-eight at the other. (Dall 1870, p. 439)

> Several species of poplar (Populus balsamifera and P. tremuloides) abound, the former along the water-side, and the latter on drier uplands. The first-mentioned species grows to a very large size, frequently two or three feet in diameter and forty to sixty feet high. (Dall 1870, p. 440)

Raymond (1870; 1900) traveled on the Yukon River in 1869. He described the forest cover from Fort Yukon to the mouth of the Ray River (called by him the Chetaut) as follows: "The vegetation on the banks and islands is principally a chaparral of willow and cottonwood, thinly intermingled with spruce, and occasionally birch." The country along the Yukon between Ray River and the Rampart Rapids was described by Raymond in the following passage: "Most of the hills are covered with groves of fir, intermingled with birch, but the trees are all small, and in many places they lie for some distance scattered in every direction, showing the small depth to which their roots attain in the frozen soil, and the great force of the winter winds." It may be suggested that what Raymond saw were the fallen snags of fire-killed trees, rather than the remains of trees that had been wind-thrown in green condition. Raymond's general view of the timber on the Yukon was expressed as follows:

> The timber of the Yukon River may in the distant future become of considerable value. It consists principally of spruce, poplar, birch, alder, and willow. The spruce and birch are the only varieties of any value for practical purposes. The former is very abundant upon the upper and middle portions of the river. It does not usually grow to a large or even medium size, and at Fort Yukon, where I had occasion to use a good deal of it, it did not appear to be of very good quality. Birch is comparatively scarce. (Raymond 1871, p. 39; 1900, p. 41)

During his military reconnaissance in 1883 Schwatka mentioned forest conditions on the upper Yukon River in the section from Dawson, in Yukon Territory, Canada, downstream to the vicinity of the Kandik River. "The country along this portion of the river is quite mountainous and well covered with timber, principally birch, spruce, and poplar, which grow to a considerable height." (Schwatka 1900, p. 342).

Captain Billie Moore in 1887, on a trip down the Yukon, noted that "After leaving Fort Yukon, there were many islands, on which grew some very good timber, principally spruce and willow." (Chase 1947, p. 141).

Russell (1890) recorded forest conditions in the upper Yukon region several times in his notes on the surface geology of Alaska.

Above the Lower Ramparts for a distance of about 250 miles the Yukon flows through a low, densely wooded region, which is frequently swampy and widely overflowed during spring freshets. (p. 112) On looking down on the lowlands from hills near their border--the best view that I obtained was from the summit of a hill about one hundred miles up the Porcupine [vicinity of Old Rampart?]--one sees winding lanes opening out through the forest, carpeted with bright green Equisetums, and overshadowed by tall spruce trees or slim, gracefully bending willows. These picturesque lanes mark the positions of recently abandoned watercourses. The most recent of these old channels still hold ponds or sloughs, about which moss grows with great luxuriance. Those of older date are indicated by a change of tint or a variation in the luxuriance of the forest trees, and may be easily recognized in a wide-reaching view.

The vegetation on the lowlands is composed mainly of spruce trees, growing close together and attaining a height of sixty or seventy feet or more.... The dense forest of spruce rising above the moss is about all that distinguishes the low swamp lands along the Yukon from the tundra of the coast. (p. 113)

The lower hundred miles of the latter [Porcupine River] offers an especially interesting region for such study. This portion of the Porcupine flows through a low, densely forested region, which is an extension of the lowlands of the Yukon already described. (p. 120) They [the outer curves of the banks of the Porcupine River] are uniformly about twenty feet high, and densely covered with fully grown spruce trees. The river has cut a swath through the forest and left the trees standing on its border as the grain stands beside the path of the reaper. On the inner curves the banks are low and gently sloping, and near the water are bare of vegetation. Proceeding up the shelving shore one comes first to coarse grasses and yellowish-green Equisetums. Beyond this belt is a growth of young willows, which increase in height away from the river, and soon form a dense growth thirty or forty feet high. Mingled with the willows and replacing them on the landward side are clumps of alders and groves of poplars. Beyond this belt lies the unexplored spruce forest, which stretches away for miles and densely covers the land to and beyond the distant hills. (p. 121)

Coolidge (1897) writing of the Fort Yukon district, stated that

The largest and most valuable tree found in this district is the white spruce, which is found over the whole country a short distance inland, but the largest and most vigorous in the vicinity of running water. It attains not unfrequently the height of fifty to one hundred feet, with a diameter of over three feet near the butt; but the most common size is thirty or forty feet and twelve to eighteen inches at the butt. (p. 154) The tree next of importance in the economy of the inhabitants is the birch. This tree rarely grows over eighteen inches in diameter and forty feet high. (p. 155)

Ogilvie (1898) commented on the tendency for the best timber to be restricted to riverbank situations in the upper Yukon country. He wrote,

> Take the best part of this timber area, and trees 15 to 18 inches in diameter are scarce, and you seldom find one 20 inches. At the boundary [between Alaska and Yukon Territory, Canada, on Fortymile River], when I wanted to erect my transit, I wanted a tree 22 inches, and after a three day's search by five men over a radius of 2 miles, the largest tree we found was only 18 inches in diameter at 3 feet above ground.

Ogilvie's need for a tree at least 22 inches in diameter is made clear in another publication.

> Before leaving Toronto I got Mr. Foster to make large brass plates with V's on them, which could be screwed firmly to a stump, and thus be made to serve as a transit stand. I required a stump at least 22 inches in diameter to make a base large enough for the plates when properly placed for the transit. In a search which covered about four miles of the river bank, on both sides, I found only one tree as large as 18 inches. I mention this fact to give an idea of the size of the trees along the river in this vicinity. I had this stump enlarged by firmly fixing pieces on the sides so as to bring it up to the requisite size. (Ogilvie 1898a, p. 30)

Writing of forest conditions in the upper Yukon River region, from the Fortymile River down to Circle City, Haskell (1898, p. 194) stated that

> For the rest of the country, the surface is covered by one foot to two of moss and, underneath, the everlasting frost. On this a scrubby growth of trees is found, extending up the mountain side to an altitude of from one thousand to one thousand five hundred feet above the river. It is this which appears to those passing down the river in boats to be a continuation of the good timber seen along the banks. Timber that is fit for anything is scarce.

A letter written by Captain P. H. Ray, Eighth Infantry, on October 3, 1897 from Circle City, Alaska, includes a reference to forest conditions in the vicinity of the present town of Eagle on the Yukon River.

> I saw but few open valleys or benches that were above high water, and only one that I consider would make a suitable site for a post. This is at the mouth of Mission (Amencam) [American] Creek, which empties into the Yukon by the south, on the left bank, 20 miles below the boundary and 130 miles above this point. Here the mountains fall back from the river, leaving a level beach of several hundred acres, which is 15 feet above high water, with strong gravel banks and a good permanent landing. There is an abundance of good saw timber in the immediate vicinity. (Alger 1899, pp. 66-67)

Griffiths (1900) reported that the timber in the vicinity of the South Fork of the Fortymile River was scattering and small. He continued,

> As you advance from the last-named stream [the South Fork of the Fortymile River], however, it [the timber] grows thicker and somewhat larger. All the streams and valleys are heavily timbered, the principal variety being spruce. Along the Yukon, above Eagle City, there is some good saw timber, although it has been materially thinned out by loggers who furnish the steamboats with fuel and contract for logs for sawmills along the river.

Rice (1900) also reported sparse timber on the Mosquito Fork of the Fortymile River.

Barnard (1900) reported on the Fortymile Quadrangle, stating that of the entire area of 2,069 square miles, 69 percent was covered with timber, 28.4 percent was barren, lying above timber line, and 2.6 percent represented burned-over timberland. He indicated that the quadrangle was fairly well timbered, excepting burned areas, up to an altitude of about 3,000 feet.

> On the north slopes higher up the timber is scrubby, but the trees retain a good size in the high, protected gulches and gaps even to 3,200 feet. The largest and most valuable timber is the white spruce (Picea alba), which attains a height of 50 to 100 feet and a diameter of 15 to 22 inches. This wood is close and straight grained, easily worked, and quite durable. Next in importance is the white birch (Betula papyrifera), which reaches a diameter of 12 inches and is the only hardwood found in this section. It is found on the flats and low foothills. Several species of poplar (Populus balsamifera and P. tremuloides) are found along the water courses, frequently occurring in groves. They attain a diameter of 4 to 6 inches, but are soft and of very little use save for fuel.

Schrader (1900a, pp. 460-461) indicated that on the Chandalar (called by him Chandlar) River as on the Koyukuk the principal timber was spruce.

> In the flats along the Chandlar River the stand of spruce is much the same as elsewhere in the Yukon Flats. It varies from dense to thin, with occasionally more or less barren areas. The trees, which seem in general to be young, probably average less than a foot in diameter at the base. In certain localities, however, some exceed 2 feet and attain a height of nearly 100 feet. In the mountainous part of the valley, below West Fork, the timber line rises to an elevation of about 2,600 feet. One of the best timber areas, covering probably one hundred or more square miles, occurs in the lowland southwest of the Big Bend below West Fork. Here the timber is nearly all spruce. On the granitic belt of rocks along the south side of the valley, from a point opposite East Fork nearly to Granite Creek, the timber is represented principally by a fair stand of young birch. Above Chandlar Lake the timber line usually rises but a few hundred feet above the edge of the valley flat, where the timber already becomes quite dwarfed. In the more open tributary gulches, however, the timber may ascend considerably higher, but usually ceases at a height of 600 or 700 feet above Chandlar River Valley, nor does any occur much above the head forks, at about 7 or 8 miles above Robert Creek portage.

In 1902 Schrader stated that in the upper Dall River region "...good timber, principally spruce, abounds...."

Macoun (1903, p. 93) quoted as follows from a lecture delivered by Judge James Wickersham at Seattle on November 5, 1901 and at Tacoma on November 11, 1901: "Forests of good timber, all sufficient in size and quantity to supply local needs, fill the Yukon and tributary valleys, the best lying around Fort Yukon above the Arctic Circle." Macoun was Assistant Director and Naturalist of the Geological Survey of Canada.

Cantwell (1904) had occasion to observe forest conditions along the Yukon River during the period 1899-1901.

> The heaviest growth of timber is found along the small tributary streams draining the lateral valleys of the Yukon system and on some of the sloughs of the main river. It is probable that the mean annual temperature is higher in these localities than it is directly on the shores of the main stream, and it is certain that the valleys are more sheltered from the wind. This will no doubt account for the larger growth attained by the trees in these localities.
>
> The most important of all the forest trees in this region is the white spruce (Abies alba). This beautiful conifer attains a height in some favored localities of over 100 feet, with a diameter of over 4 feet at the butt. The stump of one tree I examined at Dall River measured 3 feet across the top, which was 4 feet above the ground, and the annual rings showed that the tree had reached the age of 90 years. The average size of the spruce trees found along the Yukon is, however, considerably less, and in exposed situations show signs of climatic repression.
>
> Great inroads have been made in the spruce forests along the immediate banks of the Yukon to supply fuel for the steamboats plying on the river, and in certain localities the shores have been almost entirely denuded of timber. (pp. 117-118)

In the discussion of forest conditions on the Tanana, Cantwell (1904) was quoted in connection with the difficulty that an army contractor, George Sharpe, had in obtaining 600,000 feet of saw logs for use at Fort Gibbon. Prior to attempting to find suitable timber on the Tanana, Sharpe had

> ...made a thorough examination of the Yukon River banks from the Ramparts to a point 75 miles above the Dall River, and informed me that in all this region he did not find enough timber of the size required to warrant him in setting his men to work. (p. 118) The incident is related as evidence of the fact that at the present time nearly all of the available timber of merchantable size has been cut off along the banks of the Yukon and its tributary streams in this vicinity. (p. 91)

Prindle (1905, p. 39) described the forest on Jack Wade Creek in the Fortymile region as follows: "There is considerable timber on the northwest slopes of the valley, and a light growth of spruce on the southeast. The valley floor is generally covered with willows, but in the wider portion, toward Walker Fork, is well timbered with spruce and aspen." He reported the slopes of Walker Fork "...covered with a light growth of small spruce, and the valley floor in places has produced timber of sufficient size for mining purposes." (p. 42)

The Porcupine River valley was characterized by Kindle (1908) as "Entirely without topographic relief, this extensive region is covered with muskeag, spruce forest, and willows. The latter occupy the intermediate border between the swampy muskeag and the better drained spruce forest tracts, as well as the areas subject to river overflow."

The general forest conditions in the Fortymile Quadrangle were described by Prindle (1909, p. 12) as follows:

> The spruce is the predominant tree, but aspen and birch are common, and there is a thick growth of alders and willows along many of the streams. Spruce is abundant and of considerable size in the valleys of the larger streams, and throughout the area it covers the slopes as high as the climatic conditions permit, and the lower ridges in the vicinity of the main drainage lines are covered with it, together with a small proportion of birch. Dwarf birch and scattered bunches of alders are common on the higher ridges. The spruce is of sufficient size to furnish a limited quantity of logs 12 to 15 feet or more in length and a foot in diameter. It has been used generally for sluice boxes and to some extent for dredge building.

Forest vegetation conditions along the boundary between Alaska and Yukon Territory, Canada, in the region between the Porcupine and Yukon Rivers, were described by Cairnes (1912, p. 21). Survey work commenced at the Orange fork of the Black River and extended northward about 60 miles.

> The valleys are generally well timbered and about one-third of the entire country is forest clad, the northern and eastern slopes being considerably more open than the southern and western hillsides; timber line extends to about 2,900 feet above sea-level. The spruce is the most important of the trees and constitutes about one-half of the forest growth of the district, extending on timbered hillsides in most places to an elevation of 2,400 feet.... Specimens having 21-inch stumps were noted in some of the valley-bottoms, but the larger individuals generally range from 12 to 16 inches, and a tree of 18 inches in diameter, 3 feet from the ground is somewhat exceptional.

Cairnes collected specimens of the tree species and listed white spruce, aspen, balsam poplar, northern canoe birch, and tamarack. The more important shrubs listed by Cairnes were juniper, five species of willow, two species of alder, dwarf birch and "soapollali" [presumably soapberry, Shepherdia canadensis (L.) Nutt.] He also noted that

> The two varieties of poplar ['aspen poplar' and balsam poplar] are very plentiful both on the valley floors, and on the hillsides; these have stumps, generally less, and rarely more than 10 inches in diameter. Northern canoe birch occurs in occasional small groves both in the valleys and on the mountain sides, but it rarely has stumps exceeding 10 inches in diameter. Larch was only found in one locality, and only a few small specimens of this tree were noted.

Nellas (1913) described vegetation conditions along the international boundary from Rampart House on the Porcupine River, northward:

> The location of the spruce timber is shown on the map in green; on the hills it runs up to 7 inches in diameter, along the creeks some of the trees are 14 inches, and hold it well to the top. Where the timber is there is practically no underbrush. The valley of Sunaghun creek is thickly covered with buckbrush (Arctic birch), with patches of spruce along the creek. The flats at the mouth of Rapid river are covered with a young growth of spruce, with heavy timber along the stream and tributaries. The bush goes up the mountain-sides in patches not higher than 300 to 400 feet, and disappears altogether about 3 miles west of the line.
>
> All the tributary streams at the headwaters of the Old Crow river have spruce up to 14 inches along their banks; this extends in places up the mountainsides as high as 300 or 400 feet, and covers many of the low ridges, but the growth is much smaller, there being very little underbrush, and the ground covered with moss. In this district, where the ground in the valleys is not covered with bush it is covered with buckbrush and willows.
>
> The valleys of the Firth river [draining northeastward to the Arctic Ocean] and its tributaries have spruce bush similar in size and location to those of the Old Crow river, but not in such large quantities.

Nellas evidently employed the term "bush" in the colloquial sense of "forest," as is common in Canada.

Cairnes (1914, p. 11), writing of the forest along the Yukon Territory-Alaska international boundary in the section between the Porcupine and Yukon Rivers, expressed the view that

> In the vicinity of Yukon river, about one-third of the land surface is forest clad, but as the Porcupine is approached, this amount becomes reduced to about one-forth or less, and the timber is noticeably more sparse. Throughout the district, the southern and western slopes are considerably better forested than the northern and eastern hillsides. To the south, timber ceases in most places at an elevation of about 3,000 feet above sea-level, but trees grow in protected draws up to 3,500 feet. In the northern portion of this belt, trees seldom occur at an elevation exceeding 2,000 feet.

Mertie (1929, p. 105) supplied the following information on forest vegetation in the Chandalar-Sheenjek region of the upper Yukon district.

Spruce is the principal timber in the valley of the Sheenjek; the trees range in size from some 2 feet in diameter in the lower valley to the typical scrubby spruce of the upper wooded slopes. Several varieties of poplar are also common. Birch grows usually in the interior on well-drained lands, commonly hill slopes, but much of the timbered area of the East Fork of the Chandalar and the Sheenjek River is boggy bottom land, so that birch is rather uncommon. The best birch on the East Fork of the Chandalar River was seen on the gravel benches on the west side, between Crow Nest Creek and the Wind River. Birch is also found in the lower part of the Koness River and on the Sheenjek River. Birch is highly prized by the natives, being used by them for snowshoes and as frames for their skin boats. Willows and alders grow in profusion in the swampy bottom lands, usually as high underbrush. Birch brush, or dwarfed black birch, occurs in in this region as a low underbrush but not so plentifully as south of the Yukon. Timber line ranges from 2,000 to 2,500 feet, depending upon local conditions, but in the valleys of the larger streams timber may follow up a main valley to an altitude of 3,000 feet.

The views expressed as to early-day forest conditions in the Upper Yukon River region differ widely. Some observers used expressions such as "timber plentiful," "well timbered country," and "densely wooded" in describing the forest cover of the region. Others reported that accessible stands of timber-size trees were scarce as, for example, in the vicinity of Fort Yukon and near Fort Gibbon. There may be a number of reasons for the differences of opinion as to forest conditions. First, the region is very large and a statement that is true in one area may be false in another section. Second, it is quite certain that the concept of timber differed with different observers. Third, and this was probably very important, forest conditions in the region were often judged by what was seen immediately adjacent to the large waterways which were also the main avenues of early travel. As was mentioned previously, tree growth along the rivers is generally better than that further back on flat or gently rolling land that is poorly drained.

White spruce trees growing in favorable situations, especially along streams, occasionally reached diameters of as much as 30 inches but trees approaching this size were so exceptional that they were objects worthy of special note. Heights of 100 feet were observed but they, too, were the exception and very far from the rule. Back from the streams the lowlands, then as now, bore poor stands of small black spruce. Birch stands were frequently encountered on well drained situations, as gravel benches. Balsam poplar was common on alluvium along rivers with flood plains and occasionally attained diameters of 24 to 36 inches and heights of 60 feet. Timber line varied considerably but was most frequently placed at around 2,500 to 3,000 feet elevation.

LOWER YUKON RIVER

Vrangel' (1839 p. 143) quoted from the journal of boatswain's mate Andreas Glasunow (or Glazunof) who conducted an exploration of the lower Yukon (Kwichpack) River in 1833-1834. Glasunow reported that on the Anvik River the forests were tall and dense; spruce (called Tanne, Pinus Abies), in particular, was stated to be suited to every type of construction. Ternaux-Compans (1841 p. 8) included this same information from Glasunow. On descending the Yukon, Glasunow referred to the banks of the river as steep, sandy, and covered with dense forest (Vrangel' 1839, p. 148).

Glasunow was evidently the first European to visit the native village of Anulychtychpack on the Yukon River. This village was located near Ghost Creek, in the vicinity of the present town of Holy Cross. It was notable for its very large kashim, or community house. Ternaux-Compans (1841 p. 19) quoted Glasunow as stating that the kashim at Anulychtychpack was the largest he had seen. Each side was supplied with three rows of benches.

Zagoskin visited this village in 1843; it was called by him Anilukhtakpak (Aniluhtakpak or Aniluxtakkak). He, too, was impressed by the size of the kashim, constructed from native and probably local timber. The building was 84 feet square, and more than 42 feet high, with three tiers or rows of benches. The latter were made of spruce boards three and a quarter feet wide and were apparently cleaved and squared by means of stone axes (Zagoskin 1847, vol. 84, p. 56; Zagoskin 1848-1849, vol. 1, p. 174; Zagoskin 1848, p. 635). Both the village and kashim were also mentioned by de Laguna (1947, p. 77). Osgood (1940, p. 297), during his studies of Ingalik material culture, obtained from original sources, the following information on the side benches used in the native kashims:

> To make the lengthwise bench planks the natives split in half large dry spruce tree trunks. These have such large diameters (about 2 feet) that sometimes one plank suffices to make up the whole width of the bench. At most, two planks are placed side by side. The split smooth surface of the plank is the top of the bench and is about 48 inches above the floor surface. The other convex surface the makers smooth off so that the plank is only about 8 to 10 inches thick.

During his travels on the lower Yukon in 1843 and 1844 Zagoskin ascended the river as far as the mouth of the Nowitna, or perhaps a little above. He noted in 1843 that along the Anvik River there were spruce, birch, and poplar forests containing tall trees (Zagoskin 1847, vol. 83, p. 52; Zagoskin 1848-1849, vol. 1, p. 24). A diary entry of June 16, 1843 relates to conditions in the valley of the Yukon above the mouth of the Koyukuk River. Zagoskin recorded that

> A spruce forest of timber trees, poplar, birch of two and three embraces[3] in circumference, quaking aspen, alders, and four species of willow line the banks of the river [Yukon], but do not extend back into the Interior more than ten miles except along the tributaries and on the slopes of the mountains. Larch trees of timber dimensions are not to be found but trees of this species four inches in diameter occur in groups on the dry tundra on both banks of the Kvikhpak [Yukon] River. (Zagoskin 1847, vol. 83, p. 15; Zagoskin 1848-1849, vol. 1, p. 133; Zagoskin 1848, p. 621)

Conditions in the general vicinity of Nulato were described as follows: "Fairly thick birches grow locally up the tributary rivers Nulato and Sundakakat. Splendid groups of poplar rise here and there along the banks of the Kvikhpak [Yukon?]; ...larch, not thicker than 4 inches in diameter is scattered on the dry tundra on both sides of the river; mountain-ash occur on the slopes of adjacent mountains...." (Zagoskin 1847, vol. 84, p. 37; Zagoskin 1848-1849, vol. 1, p. 155; Zagoskin 1848, pp. 658-659).

An entry in Zagoskin's journal, bearing the date August 13 [evidently should have been 23], 1843, provides the following information:

> The forest of timber trees bordering the left side of the river [Yukon] does not extend back into the interior more than 8 or 10 miles. Beyond it are tundra and lakes, and only on hillocks grows thin larch; low willows and alders occur on the banks of the streams. It is worth notice that neither at Nulato nor along the whole extent of the Kvikhpak [Yukon] from that settlement [Nulato] down to Ikog-miut [Russian Mission] ... have we seen as big trees as those that grow in the region up the Kvikhpak [Yukon] above Nulato. There we found spruces of three embraces circumference, birches and poplars two and a half feet in diameter; here [evidently on the Yukon below Nulato] we have not seen a spruce thicker than 20 inches in diameter and rarely have found a straight and straight-grained birch. (Zagoskin 1847, vol. 84, pp. 60-61; Zagoskin 1848-1849, vol. 1, pp. 178-179; Zagoskin 1848, p. 639)

Describing conditions on the lower Innoko River, Zagoskin wrote: "The mountains which surround this valley are seen on the horizon as an uninterrupted chain which is covered with low spruce forests; timber-spruce occurs in the valley only in groves on low hills that are like islands in the low-lying tundra." (Zagoskin 1847, vol. 85, p. 8; Zagoskin 1848-1849, vol. 2, p. 49). Forest conditions were observed by Zagoskin in April 1844 while making the portage from Russian Mission (then Ikog-miut) on the Yukon to the Kuskokwim.

3/ Archaic; to measure by extending the arms about an object. An "embrace" in circumference may be interpreted as between 5 and 6 feet, or a diameter between 19 and 23 inches.

> Having ascended the left bank of the Kvikhpak [Yukon] River we walked about 7 miles through a good timber forest [apparently spruce and birch]; however, the farther we advanced the smaller became the spruces and birches and the more crooked the alders and willows. From the home of our guide on the Taljgiksiuak River [tributary to the Yukon from the southeast] the forest extended only about 3 miles over the tundra.... (Zagoskin 1847, vol. 85, pp. 27-28; Zagoskin 1848-1849, vol. 2, pp. 68-69)

Zagoskin noted that between the settlements of Russian Mission (Ikog-miut) and Takchig-miut, a short distance downstream, the banks of the Yukon were fringed by a good spruce and birch forest. (Zagoskin 1847, vol. 85, p. 143; Zagoskin 1848-1849, vol. 2, p. 109).

Raymond (1900, p. 28) wrote of conditions on the Yukon River some 50 miles below the mouth of the Tozitna, "The right bank of the river is well timbered with spruce, poplar and birch."

Dall (1870, p. 77) described the forest cover along the Yukon River near the mouth of the Koyukuk as follows:

> Close to the water grow willows and alders. A little farther back are belts of broad-leaved poplars (P. balsamifera), and on dry ground spruce (Abies alba), growing to a very large size and mixed with aspens (Populus tremuloides), whose light-colored bark and silvered leaves contrast finely with the dark evergreens. On the rocky bluffs a species of juniper is abundant, crawling over the rocks, but not rising from the soil.

Raymond (1870; 1873) stated that "The hills on the right bank [of the Yukon from Anvik to Nulato] are generally well covered with spruce and cottonwood, occasionally intermingled with a little birch. Owing to the coldness of the winter climate, none of the trees grow to a great or even medium size; the flats on the left bank and the islands are generally covered with chaparral of cottonwood and willow."

Elliott (1886, p. 416) wrote that

> Above the delta [of the Kvichpak or Yukon] large spruce and fir-trees, aspens, poplars, and plats of alders and willows grow abundantly on the banks; but they do not extend far back from the river on either side into any portions of the country, which is low and marshy, and which embraces so large a proportion of the entire landscape. Small larch-trees are also interspersed. The river is filled with a multitude of long, narrow islands, all timbered as the banks are, and which are connected one with the other by sand and gravel bars, that are always dry and fully exposed at low-water stages. Immense piles of bleached and splintered drift-logs are raised on the upper ends of these islands, having lodged there at intervals when high water was booming down.

While en route from the Yukon to the Koyukuk, Allen's second camp was on a tributary of the Tozitna River, some thirty miles from where he left the Yukon. "The heads of all the streams are surrounded by timber, and here we found no exception. Our camp was in a grove of larger timber than any since leaving the Yukon. One tree, a spruce, was nearly 2 feet in diameter." (Allen 1887, p. 95). It may be noted that the northeasterly course taken by Allen's native guides followed the ridges that form the divide between the Tozitna and Melozitna Rivers; Allen remarked that "Upon these the timber is dwarfed and scarce and water obtainable only in small pools." (p. 94)

In his reminiscences of Captain Billie Moore, Chase (1947, p. 205) mentioned a stop made at the village of Anvik on the lower Yukon in 1890. The incident recorded supplies additional evidence of the existence, in early time, of occasional large spruce trees.

> Here Mary purchased some wooden dishes. One was a tub, made from the stump of a large spruce tree which had been hollowed out with a piece of wood bent around the top edge to keep the edge from breaking off. The size of the tub was three feet long, two feet wide, and ten inches deep. The natives here make many kinds of wooden dishes, from roots and stumps, and pieces of wood.

Petroff (1891b, p. 13) wrote that

> The banks of the Yukon throughout this region [Holy Cross] are densely wooded, but the forest does not extend far inland. Within a few miles the thoroughfare merges upon a boundless tunstros [sic] or swampy plain, consisting of a thin crust or soil, with a luxuriant growth of moss and grasses from a substratum of frozen soil and ice, which can always be reached within a foot or two from the surface at all times of the year.

Greenfield (1893, p. 121) commented on the forest of the lower Yukon River in his report on the sixth or Yukon District at the Eleventh Census.

> For many miles on the lower river [Yukon] the banks are devoid of timber other than a stunted growth of willow brush, alder, and cottonwood. The first spruce timber is seen some 50 miles below the Russian Mission, at Ikogmiut, and from there up to its head the river is more or less belted with timber, spruce, fir, hemlock, birch, alder, and cottonwood being the varieties most abundant. On the low islands and flats the spruce attains a considerable size, but as lumber it is not adapted for any purpose beyond the needs of miners and others in the country, being checked by frost and full of knots. The growth of timber seems to be entirely confined to the margins of the streams and rivers, in many instances being merely a fringe on the banks.

Greenfield was incorrect in his statement that fir and hemlock occurred in the valley of the Yukon.

In 1898-1899 the steamer "Yukoner" wintered about 5 miles above Russian Mission on the Yukon River. Curtin (1938) published an unofficial log which contains two entries bearing on forest conditions in the vicinity of the winter quarters of the "Yukoner." An entry on October 31, 1898 reads as follows:

> The evergreen trees here are rather small, few of them being a foot in diameter. I do not know what variety they are, spruce, I think. Their branches hug their trunks, sloping downwards and giving them a narrow shape; their needles are short and dark green. There are numerous birch trees scattered around, some poplars, and lots of brush about as high as a man's head, and so thick it is almost impossible to travel without clearing a path. The birches are large enough for the natives to make canoes from their bark. The wood does not burn well because it is so green. (pp. 69-70)

A second entry, on April 3, 1899, is of equal interest:

> I was out in the woods all day with the Captain and Johnson. Johnson cut a tree large enough to hew out a plank ten inches by three inches by thirty feet, to repair the barge with. The Captain and I helped. Johnson squared off the log until it was ten inches wide and then began to cut down the sides for the three-inch width. He cut notches along the edge, and the Captain and I roughed them down with axes, and Johnson did the finishing with a broadax. (p. 182)

In 1900 Osgood reported on a biological reconnaissance of the Yukon River region.

> At the mouth of the Tanana the hills become smaller and the river much wider. Here, at Fort Gibbon [a military post on the north bank of the Yukon], Dr. Bishop found the larch (Larix americana) quite abundant. This was the only point at which it was seen by any of our party. The Lower Yukon beyond the Tanana is very uniform in character. The banks are low and rolling and overgrown with willows and alders; farther back are higher hills covered with poplars and birch; occasionally the summits of a few hills higher than the rest are devoid of trees. On the sandy islands the willow thickets are impenetrable, and where a cut bank exposes a section of them their slender perpendicular trunks stand so closely as to present a solid front like a thick hedge or canebrake. Thus it continues until the limit of timber is reached at Andraefski [a post established by the Russians on the right bank of the Yukon, near the head of the delta], 90 miles above the mouth of the Yukon. (p. 14)

White (1904, p. 261) also placed the limit of timber in the lower Yukon River valley at Andreafsky.

> Andreaofsky, on the Swetlaretchka River [Clear River], about 2 miles from its mouth and some 125 miles from the mouth of the Yukon, is one of the oldest trading posts on the river. This is the inland border of the tundra. In the ravines are a few spruce, the first straggling outpost of the forests, but around the mouth of the river are the same willow-covered flats as before.

Stoney (1900, p. 60) crossed from the Kobuk River drainage to the Koyukuk and traveled down the latter to its junction with the Yukon. He wrote that

> On the right bank [of the Yukon], five miles from the mouth of the Koyukuk, a peak, 1500 feet high, called Be-ne-le-rah-cher (big mountain) rose abruptly from the water; the sides sloped one-third the way down and then fell perpendicularly to the water. Along the right bank of the Yukon was a mountain range, thickly wooded with spruce; along the left bank the wood was poplar and cottonwood.

Cantwell (1904, p. 118) thought that "...in some localities, as in the vicinity of Nulato, it [birch] forms the predominating feature of the forest growth."

The comments of Stuck (1914, p. 329) relative to the mining camp at Iditarod, on the Iditarod River which is tributary to the Innoko, sheds some light on forest conditions in that area around 1910. He wrote:

> Three long parallel streets of one and two story wooden buildings, with cross streets connecting them, made up the town. Because the country is poorly timbered, the usual log construction had yielded in the main to framed buildings, and great quantities of lumber had been brought the previous summer from Fairbanks, and even from Nome and the outside, to supplement the low-grade output of the two local mills.

Conditions for forest growth were less favorable in the lower Yukon River region than in the upper Yukon River country. The lower limit of forest growth on the Yukon was placed in the vicinity of Andreafsky. In the lower Yukon region the white spruce was usually smaller than that found in the upper portion of the Yukon basin. Evidently maximum diameters were seldom as large as 18 to 24 inches and much, if not most, was 12 inches or less. As in other sections, the best forest growth was restricted to stream bank situations and other well drained sites. Extensive areas of the lowlands were tundra or bog, at best supporting only poor stands of black spruce. Larch of small size, up to 4 inches diameter, was observed. Balsam poplar occurred along the rivers and birch was prominent on well drained situations, as in the vicinity of Nulato.

SEWARD PENINSULA - KOBUK RIVER - NOATAK RIVER

The earliest mention of trees and forests on the Seward Peninsula that is known to the present writer occurs in Sauer (1802, p. 258). In August 1791 Sauer was in what he called the bay of St. Laurence, Bukhta Lavrentiya of modern Russian maps, on the southeast coast of the Chukotsk Peninsula, Siberia, across Bering Strait from Cape Prince of Wales. The following statement by Sauer was evidently based on information obtained from the Tschutski, natives of eastern Siberia. "The bay formed by the two capes, Prince of Wales and Rodney, is named Imagru [now Port Clarence], the

deepest part of which is the discharge of a considerable river called Ka-ooveren [the modern Kuzitrin River, which flows westward from Kuzitrin Lake to Imuruk Basin]; near the source of which, the natives say, the country is well wooded."

Kotzebue (1821, p. 205-206) in 1816 named a small island at the entrance to Shishmaref Inlet, on the northern shore of the Seward Peninsula, Sarichef Island. He stated, "We observed much drift-wood on Saritscheff Island, and among it, stems, which were so thick that we could not span them with our arms." The source of this driftwood cannot be stated with certainty but it may well have come from the Buckland River, the Kobuk, or the Noatak.

Zagoskin stated that in the interior of the Seward Peninsula, particularly in the southern part adjacent to Norton Sound, there were spruce forests of "lofty" trees, birch, poplar, aspen, shrubby alder, various species of willow, mountain ash [presumably Sorbus scopulina Greene], and arrow-wood [presumably Viburnum edule (Michx.) Raf.] (Zagoskin 1847, vol. 83, p. 99; Zagoskin 1848-1849, vol. 1, p. 71). An entry in Zagoskin's journal on December 16, 1843 refers to forest growth on the Unalakleet (Unalaklik) River, tributary to the eastern end of Norton Sound. He wrote that shrubby alders and willows were first encountered along the river banks about a mile and a half above the river mouth. Further upstream the shrubby growth gave way to a spruce forest of timber trees. He remarked that the forest did not extend back from the river banks more than 1,200 to 1,800 feet, then giving way to tundra (Zagoskin 1847, vol. 83, p. 154; Zagoskin 1848-1849, vol. 1, p. 83; Galitzin 1850a, pp. 223-224). On January 18, 1843 Zagoskin (1848, p. 551) reported traveling N. 67° E., partly on the Katolitno (tributary to Unalakleet River) and partly through conifer forest which contained groups of tall timber trees.

Seemann (1852-1857), botanist on the voyage of the "Herald" reported (pp. 17-18) that,

> About Norton Sound groves of White Spruce - trees and Salix speciosa are frequent; northwards they become less abundant, till in latitude 66° 44' 0" north, on the banks of the Noatak [River], Pinus alba [= Picea glauca (Moench) Voss] disappears. Alnus viridis [= A. crispa (Ait.) Pursh] extends as far as Kotzebue Sound where, in company with Salix villosa [unknown to Hulten, Flora of Alaska and Yukon], S. Richardsoni [= S. Richardsonii Hook.], and S. speciosa [= S. alaxensis (Anderss.) Cov.], it forms low brushwood. With the commencement of the Arctic circle Alnus viridis ceases to exist; Salix speciosa, S. Richardsoni, and S. villosa extend their range farther, but are only for a short distance able to keep their ground; at Cape Lisburne, in latitude 68° 52' 6" north, they are in the most favorable localities never higher than two feet, while their crooked growth and numerous abortive leaf-buds indicate their struggle for existence.

In discussing Pinus (Abies) alba Ait. [= Picea glauca (Moench) Voss], Seemann (1852-1857, p. 41) stated that it was

> The northernmost tree on the northwestern coast of America, forming forests on the banks of the river Noatak, being nearly seven degrees further north than the limits of the woods on the Eastern shores of the continent. Some of the trees measured by Lieut. Bedford Pim, R. N., were from twenty to fifty feet high, and from four to five feet in circumference [15 to 19 inches diameter]. Sections of them are preserved in the Museum of the Royal Botanic Gardens, Kew.

Simpson (1852, p. 93), who served as surgeon on the British ship "Plover," recorded some interesting observations relative to tree growth in the region under consideration.

> The trees on the Kó-wuk [Kobuk River] were not measured, but on a previous excursion to the Spafareif River [draining into a bay of the same name] on the south side of Kotzebue Sound, I had found pines [spruces] fifty nine inches in girth [19 inches diameter] above the snow, and Mr. Martin, in February, had measured several upwards of sixty inches in circumference [19 inches diameter], at not less than six feet from the ground, on the banks of two considerable streams that fall into the north-west extremity of Hotham's Inlet, within the eixty-seventh parallel.

In a later report Simpson (1855, p. 918) wrote as follows: "All these rivers have been identified by different officers from the "Plover" having visited their embouchures, and those falling into Hotham Inlet were found bordered with large pine [spruce] trees. The natives add, that trees also grow on the banks of the rivers in some parts of the interior." That trees of timber size occurred on streams draining into Hotham Inlet is strongly suggested in an entry made by Simpson (p. 932) describing a large native house near the entrance to the Inlet. "The walls were only three feet high and inclined slightly inwards the better to support the sloping roof, which, like them and the flooring of the recesses, was made of boards nearly two feet broad, quite smooth and neatly joined." The interior of this habitation "...was in shape something like three sides of a cross, twenty feet by sixteen...."; at the time of Simpson's visit six families occupied the dwelling. Dall (1869b) mentioned that a native kashim, or community house, on Norton Sound "...about thirty by forty feet square, had on each side shelves or seats formed of one plank, four inches thick and thirty-eight inches wide at the smaller end. These enormous planks took six years to make, and were cut out of single logs with small stone adzes." This building was also noted by Morris (1898, p. 112).

Whymper (1868) traveled from the village of Unalakleet up the Unalakleet River some 25 miles, then passing over to the Yukon River. He remarked that "We were surprised at finding this a well-wooded country. Spruce, birch, and willow are abundant within a few miles of the seacoast." Whymper's impression of the Unalakleet section was similar to that of Zagoskin (1847; 1848-1849), mentioned earlier.

Rothrock (1868), in his sketch of the flora of Alaska, included a letter from H. M. Bannister, who spent the winter of 1865-66 at Fort St. Michael, on Norton Sound. Bannister wrote:

> I am sorry that I can give from personal observation so little information concerning the trees of Russian America. At St. Michaels there were not trees, and the only bushes which rose above the ground were stunted alders and willows. At the head of Norton sound, however, a forest of spruce trees extends nearly to the coast, and occasional trees are seen on the immediate shore. These trees usually are from 20 to 45 feet high and not more than a foot in diameter.

Dall (1871) described a winter journey as follows:

> We will start from Ulokuk [Ulukuk, on the Unalakleet River], an Indian village on the portage between the Yukon and Norton Sound, and bring up at Unaloklik [Unalakleet], an Eskimo village on the coast, thirty miles away. We keep on our way through thick spruce groves where the trees may average eighteen inches in diameter and forty feet high. In the interior, on the Yukon, they grow much larger, but all the trees diminish in size and abundance as we approach the coast, where there are none at all. The Aspen (Populus tremuloides), the Spruce (Abies alba), the Poplar (Populus balsamifera), and the Birch (Betula glandulosa), are the largest and most prominent trees. There are no true pines, though the settlers call the spruce 'pine'.

Muir (1883) was on a cruise of the Revenue Steamer "Corwin" in 1881. Writing of Kotzebue Sound he observed that "On several points about the sound the white spruce occurs in small compact groves within a few miles of the shore; and pyrola, which belongs to wooded regions, is abundant where no trees are now in sight, tending to show that areas of considerable extent, now treeless, were once forested." He visited Golovnin Bay, on the south side of the Seward Peninsula:

> This is one of the few points on the east side of Bering Sea where trees closely approach the shore. The white spruce occurs here in small groves or thickets of well developed erect trees 15 or 20 feet high, near the level of the sea, at a distance of about 6 or 8 miles from the mouth of the bay, and gradually become irregular and dwarfed as they approach the shore. Here a number of dead and dying specimens were observed, indicating that conditions of soil, climate, and relations to other plants were becoming more unfavorable, and causing the tree-line to recede from the coast.

Cantwell (1887) ascended the Kobuk River (then called the Kowak) and noted forest conditions at several points. A map accompanying his report indicated heavy timber along the river at about longitude 158° 30'. Conditions above the native summer fishing camp of Unnatak on the Kobuk River, near the mouth of Ambler River, about latitude 67°, longitude 158°, were described as follows: "Our camp was made under the protecting branches of a dense

growth of spruce which bordered the stream. The timber along this part of the river is as heavy as seen anywhere; the trees are from eighty to one hundred feet high, and from ten to fourteen inches in diameter. Some trees were observed much larger, but they formed the exception to the general rule." The attention of Cantwell was attracted to large groves of balm of Gilead (balsam poplar).

Writing of conditions on the Kobuk near longitude 154°, Cantwell stated: "We pushed ahead, and my feelings can scarcely be imagined when, at 8 o'clock, we rounded a high, rocky bluff and came suddenly in sight of a seething mass of white-water bursting its way through a gorge composed of perpendicular masses of slaty rock two hundred to three hundred feet high, surmounted by a forest of spruce and birch." Cantwell observed the results of an interesting phenomenon known also along other Alaskan rivers.

> When the river opens in the spring and the accumulation of ice begins to move toward the sea the signt must be inexpressibly grand. The tremendous pressure tears asunder the banks, upheaves huge boulders, and I have seen places where a large mass of ice had left the river bed and carved its way with irresistible force through a forest of spruce, leveling all obstructions and leaving in its path the ineffaceable evidence of appalling strength: prostrate trees, uprooted bushes, and trenches in the frozen earth six feet deep.

In 1896 Cantwell published a note on the series of ice cliffs he saw on the Kobuk River, about 80 miles above its mouth, during the summers of 1884-85. "The tops of all the cliffs were superposed by a layer of black, silt-like soil from 6 to 8 feet thick, and from this springs a luxuriant growth of mosses, grass, and the characteristic Arctic shrubbery, consisting for the most part of willow, alder, and berry bushes, and a dense forest of spruce trees from 50 to 80 feet high and from 4 to 8 inches in diameter."

McLenegan (1887) in 1885 explored the Noatak River and recorded his observations on forest conditions. "A slight growth of timber, consisting chiefly of spruce and cottonwood, is found along the immediate banks of the river." (p. 58) "About four miles above the mouth [of the Noatak] the banks became somewhat higher and the timber more plentiful, although the latter was of a very stunted growth." (p. 60) McLenegan was impressed with the difference between the forest on the Noatak and the Kobuk. He wrote (p. 59):

> There are, however, no features in common between the rivers, or between the valleys drained by them--a fact which, considering their proximity, is very remarkable. One of the most interesting facts developed by a comparison is the distribution of timber. Along the waters of the Kowak [Kobuk], spruce, the predominating variety, is very abundant, and frequently attains a diameter of two feet. On the Noatak, however, it is quite the reverse, and the timber belt is confined to a very limited portion of the valley. The cause of this marked difference is possibly owing to the elevated nature of the latter region, and possibly also to some peculiarity in the soil.

Woolfe (1893) made several references to forest growth on the Seward Peninsula and along the Kobuk and Noatak Rivers.

> Norton and Golofnin [Golovnin] bays are two deep indentations of Norton Sound. Steep cliffs and bold headlands characterize these sheets of water, and upon the rocky slopes along the water side stunted spruce grow thickly. (p. 130) Within a quarter of a mile of the sea groves of spruce grow thickly, but the size of the tree never exceeds 40 feet in height and from 6 to 10 inches in diameter. The wood is poor, full of knots, and unfit for working up, unless to construct log houses or other rude dwellings. Golofnin bay, on its western slopes, marks the limit of the growth of trees of any size. The coast hills that trend toward Point Spencer, near Port Clarence, are devoid of trees, and the supply of material for building and fuel is obtained by the people living in this district from the driftwood that lines the beach in high windrows. The blasting effect of the northerly winds operate against any growth of trees on this portion of the country, but the tree line appears to follow the east side of Golofnin bay, sweeping in a northeast direction to the Kugaluk river, emptying into Kotzebue Sound [at Spafarief Bay]. Between Norton and Golofnin bays, to the northward, the arboreal conditions are similar, cottonwood and a few birch trees being found in the vicinity of the groves of spruce. (p. 131)

Woolfe also recorded his impressions of the tree growth on the Kobuk and Noatak Rivers.

> Proceeding along the northern coast of Kotzebue sound we find the large river Kowak, or Putnam [now Kobuk], debouching into Hotham inlet. Just at the mouth of the inlet the Inland or Nunatak river [now Noatak] empties its waters. Belts of spruce, birch, and a bastard pine line the country through which the two rivers flow. The timber limit of the Arctic district extends to the west bank of the Nunatak river as far north as 67° latitude; thence it pursues an easterly direction to the headwaters of the Kowak, or Putnam, river.... (p. 132)

On July 19, 1885 George M. Stoney set up a sawmill on the right bank of the Kobuk River, about 90 miles above its mouth. Later, on August 11, this mill was moved upstream to the winter quarters called Fort Cosmos, near longitude 157°. It was reported that the vicinity of Fort Cosmos was well wooded. Stoney (1900, p. 48) wrote that

> The Putnam [Kobuk] lies in a fine valley of diversified country varying in width from six to twenty miles. On the banks of the river and its tributaries there is a rank growth of either spruce, willow, birch, alder or cottonwood extending back for a half a mile; here and there, mixed bunches of all these woods are formed. Back of the growth is rolling tundra land with hills from 100 to 400 feet high, interspersed with numerous lakes and ponds, generally oval in shape from three to five miles long, and from three feet to three fathoms deep. The valley of the Ambler River [tributary to Kobuk from the north, near longitude 158°] is well wooded with spruce, willow, birch and cottonwood, extending well up the mountainsides. (p. 50)

> Above the An-ne-la-gag-ge-rack River [Reed River, tributary to Kobuk from the north, near latitude 67°, longitude 155°], the Putnam [Kobuk] valley narrows, and the river gets more winding and full of boulders, and the banks are high. The growth is thick, particularly the spruce, which in these higher lands has smoother bark and softer leaves. The mountains are in ridges from 1,200 to 2,800 feet high and wooded to an altitude of 1,000 feet. (p. 51)

> Fair specimens of the various kinds of trees were cut down, measured and inquiries made of the natives concerning them.... A spruce tree cut near Fort Cosmos was a good example of its kind. Height, 50 feet; N. E. diameter of trunk, the longest, 16 inches; N. W. diameter, the shortest, 13 inches. Branches began three feet from the ground, increasing in size and length to the middle of the tree, then diminishing to the top. The branches next to the ground were dead, as is always the case. Branches from three to five feet long never have a greater diameter than 2-1/2 inches. This tree inclined to the southwest (as most of them do). The roots to the northeast were longest and largest, one being nine feet long and eight inches in diameter. The depth of soil in which this tree grew was but seven inches, the smallest threads of roots went no further down. The main root extended five inches below ground. All the roots ran laterally in soil of black and gray dirt with light sand and dirt below. All the spruce trees were about like the one described. In the Putnam [Kobuk] valley the roots are longest and stoutest to the northeast; in other valleys this applies in the direction of the prevailing winds. All side roots are small and unimportant. The little soil over the roots is barely sufficient to hold the trees against the prevailing winds of summer. The snow and freezing of winter enable them to stand the gales of that season. (p. 81)

Stoney indicated that the native name for spruce was Nu-puck-tuck.

> The cottonwood grows all over the country and is found in places where no other trees grow.... The cottonwood dies first at the top, caused by the winds cracking the upper bark which lets in the cold. The native name of the tree is Nimyuk, hence so many villages of that name. (p. 81)

> The birch are clean, well-shaped trees, varying in height from twenty-five to forty feet. A specimen tree cut was 31 feet high; circumference at butt 18 inches; five feet up, 16 inches; at ten feet from the butt 13 inches. Branches began fourteen feet up, none lower, and not very many above. The largest trees all seemed dead and on them a parasite was found. Before dying, when the branches show signs of decay, a soft white fungus appears; after death this changes its color to slate or gray and becomes hard. The birch grows all through the country and is not confined to the water courses like most of the other trees. (p. 81)

Dry spruce wood was used exclusively in the boats for fuel; other dead wood gave poor results. The standing dead spruce was used; the higher the land the better the wood, having fewer knots and a straighter grain; in the low wet places the grain of the wood runs spirally. The largest tree seen in the whole country was a spruce near the headwaters of the Putnam. Dimensions, circumference at base, 80 inches [25.5 inches diameter]; six feet up, 68 inches [21.6 inches diameter]; height, 80 feet. Trees of this size, however, were seldom met with. (p. 83)

Joseph Grinnell wrote of timber conditions observed on the Kobuk River in 1898, near Hunt River, tributary to the Kobuk from the north, near latitude 67° 15', longitude 158° 30'.

We did not cut the timber [for a cabin] from near the house on account of the protection it gives us from the north winds. Trees large enough and long enough for building purposes are not very numerous, and we had to carry them a good ways. A few are as large as twenty inches at the butt, but mostly they are from ten to fifteen inches. It is all that eight of us can do to struggle along with one of these logs, they are so heavy, and we put them on rollers sometimes. Four of the men can easily carry one of the twenty-four foot logs, but a green spruce log of any size is always heavier than it looks. (p. 20)

Collier's notes on the vegetation of the Cape Nome and Norton Bay regions, based on field work in 1900, contain several references to forest conditions.

In the eastern part of the peninsula [Seward] spruce timber occurs along the rivers. Trees 1 foot in diameter and 50 feet high were measured near Council on Niukluk River. The western limit of this spruce is approximately represented by a line extending from Golofnin Bay northwestward to the headwaters of the Niukluk River, and thence northeastward to the eastern end of Kotzebue Sound. Scattered trees were seen on the portage 20 miles west of Council. This is the westernmost limit of coniferous trees on the American Continent.

Within the spruce area fuel and sheltered camping places are abundant and comfortable log houses can be built for winter use. Beyond the limits of the spruce timber, cottonwood (Populus balsamifera) as large as 10 inches in diameter occurs at a few places along the rivers.... Dwarf alders (Alnus sinuata) [= A. crispa (Ait.) Pursh] make occasional thickets on the hillsides. Along rivers and creeks generally there are dense thickets of willow, gnarled and tangled together, and often troublesome to penetrate. In favorable localities the larger willow (Salix alaxensis) sometimes attains a thickness of 6 inches and a height of 20 feet. The smaller willows, to be found on nearly all the streams, are seldom over 2 inches in diameter and 5 feet in height. These willows are the main source of fuel in the mining camps of the western part of the peninsula. Stunted and small though they are they made possible all the exploration and development in the interior of Seward Peninsula last summer. They were found in sheltered nooks as far west as Cape Prince of Wales. (Collier 1901)

In 1902 Collier reported an interesting discovery that indicates the presence in past time of much larger trees on the Seward Peninsula than are known at present. He wrote:

> On Quartz Creek [near latitude 65° 20', longitude 164° 40', tributary to Kougarok River (Kugruk of Collier) from the west; the Kougarok is tributary to the Kuzitrin] the gravels of the upper plain are overlain by frozen silts, in which the bones of mammoth and horse have been found associated with the trunks of large spruce trees. A spruce log, said by miners to be 5 feet in diameter and 80 feet long, was uncovered at this place. (Collier 1902, p. 27)

Schrader (1902) stated that "The whole of the Kobuk valley, except the lower part of the delta, is timbered; the prevailing tree is black spruce [probably white spruce], with occasional groves of birch and cottonwood. Alders and willows of various kinds line the streams and overspread the moist mountain slopes."

In 1903 Alexander De Soto testified at Nome, Alaska, before a Senate subcommittee. De Soto was manager of the De Soto Mining Company and had been in Alaska for about 18 years, off and on. When asked, "How much of the country is covered with this timber?" De Soto (1904, p. 187) replied, "There are stretches of it. I couldn't say exactly. I know what we have on the Neukluk River [Niukluk River, tributary to Golovnin Sound]. On this river I should judge there is about 9,000,000 feet. On the Fish River [an eastern affluent of the Niukluk] there is plenty of timber, and also over the range on the Anaconda." When asked whether the timber was spruce, De Soto replied that "It is what we call silver pine."

Brooks (1904, p. 45) in discussing the Kobuk River region observed that "The valley floors and slopes are clothed with spruce, poplars, and birches up to an altitude of 2,000 feet above the sea."

Moffit (1905, p. 78) worked on the Seward Peninsula in 1903 and noted forest vegetation conditions in some detail.

> Timbered land is confined entirely to the eastern part of Seward Peninsula. On the southern side of the Bendeleben Mountains scattered spruce trees were seen by Brooks in the valley of the Niukluk as far west as Libby River, which rises on the west side of Mount Bendeleben, while considerable timber was found lower down in the valley as far as Golofnin Bay. Eastward spruce grows along all the streams. On the northern side of the Bendeleben Mountains spruce is found in the valley of the Koyuk west to the vicinity of Timber Creek on the south and to the tributaries heading toward Kiwalik Mountain on the north. Scattered trees of small size were seen on Independence Creek, and good timber was found on Big Bar Creek, First Chance Creek, and Gold Run. The course of Kiwalik River and its larger tributaries, Hunter and Quartz creeks, may be readily traced at a distance by the narrow band of spruce timber lining the banks. This timber has been of great value to prospectors on

> Candle Creek, both as fuel and as material for building, so that many of the cabins at Candle are built of logs cut in the early spring and floated down the river on the high water. From this brief description it will be seen that spruce extends considerably farther west on the south side of the Bendeleben Mountains than it does on the north, and that the timber limit is farther to the west in the central than in the coast regions. Large spruce logs are not infrequently exposed in the muck and gravel of the valleys and suggest the possibility that the distribution of timber was once much greater than at present. It should be borne in mind, however, that the logs may have been derived from distant sources and have been brought to their present resting place by water at a time when the land stood considerably lower with reference to the sea.
>
> In point of size cottonwoods would be next in importance to spruce, but these are not widely distributed and are to be found only along a few of the streams. The greatest number were seen near the Cottonwood road house on the Kruzgamepa, or Pilgrim, River. A few were observed on Cottonwood Creek at the head of Goodhope River and in one or two other localities.
>
> As a rule, the willows, which are found close to the streams in nearly all the valleys, do not have a height greater than 6 or 8 feet, although certain of them reach a size almost as great as the cottonwoods and all are regarded by some of the prospectors as marking stream channels which have not varied much in position for a long time. While this is true to a certain extent, it is also probable that the character of the soil and the species of willows have much to do with the size of the tree. These willows, of which there is a great variety, from tiny shrubs of 2 or 3 inches to trees with a height of 20 feet, are the only fuel supply in the greater part of the peninsula and have made possible the exploration of the gold-bearing gravels. Winter snows have weighted them with a load greater than they could bear, and it is the usual experience to find the trunks so gnarled and twisted as to cause some trouble in taking a pack train through them.

Hopkins and Sigafoos (1951, p. 92) remarked on the buried logs exposed by placer mining operations on the Seward Peninsula, much earlier noted by Collier (1902) and Moffit (1905). "The climate of Seward Peninsula was warmer than at present during some parts of Quaternary time. Spruce and birch logs and bones of extinct mammals are found together in deposits of Quaternary age as much as 50 miles west of the present timber line."

Devine (1905) was on the Seward Peninsula in 1902, and in traveling up the Niukluk River to the mining camp of Council was impressed with the appearance of trees. He wrote (p. 172):

> They [grasses] made the valley of the Neukluk [Niukluk] resemble our own beaver meadows. It was a rare pleasure to meet with trees on the way up to Council; an agreeable change from the monotonous treeless tundra around Nome and along the Bering and Arctic coasts. The banks of the Neukluk were lined with spruce, heavy forests of it, which, as far as I

could see, was none other than our own Canadian species. The trees were there in thousands, also stunted in growth, but big enough to build houses with and furnish firewood, which is an important factor in the development of this country.

Smith (1913 reported (p. 51) that

> The greater part of the Noatak basin is timberless, and this will make development of the region difficult. The most eastern spruce in the Noatak Valley...is between the camps of August 13 and 14 [in about longitude 161° 30']. At this place trees 8 to 12 inches in diameter appear along the well-drained banks of the river as a narrow fringe. Farther downstream spruce may be found almost everywhere in the immediate vicinity of the river to a point a short distance below the camp of August 26, at the mouth, where it is again absent. Over much of the swampy lowland back from the streams and on the hill slopes timber is absent, even in the western part of the valley. The large size and sturdy growth of the trees, even near the borders of the unforested areas, is striking. Fully as large and vigorous trees were seen within 15 miles of the extreme eastern limit of timber as anywhere else in the region, although the place was fully as high, as much exposed, and had a soil not differing radically from that of the neighboring tracts.... Although spruce and other large trees are absent, some bushes large enough for fuel grow even in the headwater portions of the valley. Willow, alder, and poplar (cottonwood and balm of Gilead) were seen in the valley above the camp of August 2, and farther downstream they become more abundant and larger. In places the poplars are 6 inches in diameter and 20 feet high.

Conditions in the Kobuk River basin were described as follows (p. 53):

> Timber is found mainly along the larger streams, and,...does not extend up the mountain slopes to elevations of more than 2,000 feet in the eastern part of the basin, the upper limit gradually decreasing in altitude toward the west. On the flats in the central part of the basin trees are usually absent, except in scattered clumps here and there where the upland is not too swampy. In the lower part of the delta trees are absent. Spruce and birch are the only trees that grow to sufficient size for lumber and only the spruce is large enough for cabin logs.

The occurrence of forest vegetation along the rivers in the eastern part of the Seward Peninsula was known at an early date. In places the white spruce closely approached the coast. Trees were relatively short, 20 to 40 feet in height, and the largest were only 6 to 12 inches diameter. On the Kobuk River the largest trees encountered were around 80 feet in height and as much as 22 to 24 inches diameter. Most of the timber was much smaller. Birch up to 5 and 6 inches diameter occurred on the Kobuk. Forest growth on the Noatak was more limited in extent but individual trees 20 to 50 feet in height and 15 to 19 inches diameter were reported. Throughout the general region forest growth was quite closely restricted to riverbank situations and similar situations having good drainage.

KOYUKUK RIVER

The writings of the Russian Zagoskin supply the first fragments of information available on the forests of the Koyukuk (called the Iunna-ká or Junnaká by Zagoskin). In March 1843 Zagoskin ascended the Koyukuk at least as far as the mouth of the Kateel River, which stream (called by him the Khotyljno or Ckotyljno) he also ascended. On the left bank of the Koyukuk, near the mouth of the Kateel River, was a native village, called Khotyljkakat or Ckotyljnakat. Zagoskin noted that the river (presumably the Kateel) was fringed with "timber- and carpentry timber-trees...." "...at the request of the old man we felled four huge spruces for his summer-house." (Zagoskin 1848-1849, vol. 1, p. 113; Zagoskin 1847, vol. 83, p. 184). Two entries in Zagoskin's journals indicate camps in the Kateel River basin "...in a spruce forest of lofty trees...." and in a "...spruce forest of timber-trees." (Zagoskin 1848-1849, vol. 1, pp. 114-115; Zagoskin 1847, vol. 83, pp. 185-186). "Spruce, birch, and poplar forests of lofty trees," and willows on the low grounds, were reported to occur in the Koyukuk valley from the Kateel River down to the Yukon (Zagoskin 1848, p. 649; Zagoskin 1848-1849, vol. 1, p. 118; Zagoskin 1847, vol. 83, p. 189).

In 1885 Henry T. Allen traveled from the Yukon River along the divide between the Melozitna and Tozitna Rivers, and descended the Kanuti River (called by him the Konoótená) to the Koyukuk. His journal states that "The Koyukuk, where we first saw it, was in a single channel about 300 yards wide, with high banks, covered with moss and burnt spruce on the north side." (Allen 1887, p. 97) Allen then ascended the Koyukuk as far as the mouth of what is now the John River (called by him the Ascheeshna or Fickett). He recorded that "The trees of this locality are indeed dwarfed, and are limited to spruces, cottonwoods, alders, willows, and some birches. Their foliage had already [August 10 or 11, 1885] begun to show the effects of frost." (Allen 1887, p. 101)

Heilprin (1899) included a footnote on p. 96 relative to the forest in the Koyukuk basin:

> Late advices received from Mr. Hill [Thomas R. Hill, in charge of the expedition of the Philadelphia Exploration and Mining Company, and commander of the "Jenny M."] indicate a remarkable growth of forest along the Allenkaket or Alletna [now the Alatna], a northern tributary of the Koyukuk, the trees well within the Arctic Circle measuring sixty to a hundred feet in height, and with stocks of two feet in diameter.

Brady (1899, p. 12) referred to the forest of the Koyukuk but the source of his information was not given. He wrote: "There are forests of coniferae along the rivers of the interior, the Yukon, Tanane [sic], and the Koyukuk, the trees on the latter river attaining the size of 2 feet in diameter."

In 1899 Schrader conducted a reconnaissance of the Koyukuk. He crossed from the Chandalar River to Robert Creek, tributary to Bettles River from the east. Timber was first seen on Robert Creek about 8 miles below the summit of the portage.

> From the confluence of the Dietrich and Bettles rivers the timber, which occurs more or less all the way down the Koyukuk, is principally spruce and cottonwood. On the lower 5 or 6 miles of Slate Creek [tributary to the Middle Fork of the Koyukuk, from the east] many of the trees approach 2 feet in diameter and are 80 or 100 feet in height, while some may exceed this. Heavy timber is also reported to occur on the Allen [now the Alatna] and other large northwest tributaries. A sawmill is operated at Bergman [an old settlement and trading post on the Koyukuk, near the Arctic Circle, about longitude 153°] and one at Union City [a mining camp on the South Fork of the Koyukuk, 2 miles above its mouth, near longitude 152°]. Considerable birch also occurs on the Koyukuk. Of that observed none was larger than 5 or 6 inches in diameter. The alder and willow, both on the Koyukuk and Chandlar rivers, though often of dense and rank growth, do not attain to real tree or timber size. (Schrader 1900a, pp. 460-461)

Schrader (1902), reporting on work of the Geological Survey, stated that "A moderate growth of spruce and cottonwood extends up John river into the mountains to near the middle of the [Brooks] range. Here the timberline occurs approximately at 1,600 feet. From this point to the [Arctic Ocean] coast the only representative of timber is the willow."

Greely (1909: 52) wrote that "The Kanuti Valley also has considerable forest areas, as well as the Tozi [now the Tozitna] and the Koyukuk, the latter especially in the lower reaches where there are many large trees."

Smith (1913, p. 48) observed forest conditions in the Alatna River basin.

> Spruce is found along the valley as far as the camp of July 22 [about 15 miles below the head of the drainage]. In the southern part of the basin the trees average 10 to 12 inches in diameter and extend up the slopes to an elevation of 2,000 to 2,500 feet but the diameter of the trees and the elevation of the upper border of the forested zone gradually decrease northward until at the camp of July 20 [some 9 miles below the camp of July 22] the diameter of the trees is only 6 to 8 inches and even scattered trees do not extend more than 500 to 600 feet above the river. The northern limit of trees is so sharply defined as to make a decidedly abrupt break which seems to have been controlled by some other factors than temperature and elevation.

Smith and Mertie (1930, p. 72) later made similar observations on the abruptness with which tree growth ceased on the Alatna.

> In the valley of the Alatna spruce extends within about 6 miles of the pass to the Noatak and up the Unakserak [tributary to the Alatna] to the camp of March 17. At both of these places the northern limit of trees comes abruptly. A few hundred yards south of the actual limit the trees are of about the same size as they are for scores of miles to the south, but in that short distance they disappear entirely. On the Unakserak spruce trees 8 to 10 inches in diameter, 30 feet tall, and nearly straight, which apparently have suffered little from the strong winds or cold climate, were found at camp March 17, but 100 yards beyond there were not even dwarf trees or any signs that there had been trees within many miles.

Maddren (1913) observed that "The flats of the Koyukuk - Chandalar region are timbered, and the forest extends up the mountain slopes and valleys to an altitude varying from 2,000 to 3,000 feet...." (p. 28) He continued, (p. 29), "The timber is largely spruce, but poplar, birch, alder, and willow also occur. Spruce trees as much as 2 feet in diameter are found in the lower courses of some of the larger rivers. This size is exceptional, however, and most of the spruce averages less than 1 foot at the base."

Between 1929 and 1939 Robert Marshall traveled extensively in the upper Koyukuk River region. He was a careful observer and has left a valuable record of forest conditions in the areas visited. Although the period of Marshall's explorations is considerably later than that generally adopted as terminal for present purposes, his observations are so important that they are, in part, included here. Conditions near the forest limit in the valley of Unakserak Creek, tributary to the Alatna River from the north, were described as follows:

> Two miles below last night's camp was the last timber. Here we stopped for more than two hours while we mapped this timber location, and I made borings into a dozen trees from which I extracted wood cores and measured and counted the rings. Queerly enough, the trees came in four distinct age classes. The trees in the baby class were between 20 and 45 years; the young-age class 75 to 80 years; the middle-age class 120 to 130 years; and the old-age class 170 to 180 years. Why there should have been all those years when no trees started I could only guess. Perhaps they constituted a period when the temperature was too cold for seeds to germinate or when the germinating seedlings were killed by frost before they could get established. (Marshall 1956, p. 95)

On the upper reaches of Wild River, tributary to the North Fork of the Koyukuk, Marshall (p. 79) measured one tree over 18 inches in diameter, just a mile back from the last timber. In the vicinity of Shushalluk Creek, on the upper North Fork of the Koyukuk, Marshall recorded, "...the largest tree I had yet seen north of the Arctic Circle, a spruce twenty-one inches in diameter at breast height." (p. 120) On the North Fork of the Koyukuk, near the junction with Ernie Creek, Marshall (p. 39) observed a good stand of spruce. "One tree I measured was sixteen inches in diameter at breast

height, and about sixty trees per acre ran ten inches or more, notwithstanding the fact that the northern timber line was only four miles away." Marshall recorded that while in the Mt. Doonerak region "...I bored a windswept black spruce, growing on a swampy hillside, which was 6-1/2 feet high, 3 inches in diameter, and 346 years old. Less than two air-line miles away, was a well-drained white-spruce flat which I had studied eight years before and found to contain a stand 160 years old, with sixty trees between 10 and 15 inches in diameter to the acre." (p. 132)

Forest growth in the Koyukuk River region consisted principally of spruce with the largest trees as much as 24 inches diameter and 60 to 100 feet in height. Most of the growth was much smaller, less than 40 to 50 feet in height and 8 to 10 inches in diameter. Birch stands were noted but the trees were small, not larger than 5 to 6 inches diameter. The better forest occurred as a fringe along the river banks. Timber line was around 2,000 to 2,500 feet. Several observers were impressed with the abruptness of the northern limit of forest and tree growth.

SUMMARY

Presented here are the original sources of available information on early forest conditions in the Alaska interior. The terminal date generally employed was 1912, but a few later observations were also included. Because the information is scattered through a wide variety of publications, many of them not readily available, direct quotations are used with specific reference to the source wherever possible. As a rule, and particularly when the original publication consisted of more than a few pages, the policy followed was to indicate the specific page on which the citation occurred.

Information on early forest conditions in the Alaska interior is, for the most part, fragmentary--much of it consisting of incidental observations made by explorers and travelers. The earliest accounts of the forest generally concerned conditions along the major rivers for these represented the easiest avenues of access to a remote land in which overland travel was difficult. In the Alaska interior where permafrost occurs, forest growth along the waterways is usually superior to that found back from the rivers on flat or gently rolling land where permafrost is present at shallow depth. This unquestionably led some of the earliest observers to the opinion that the forest cover was more general than was actually the case and it also led some of them to overly generous notions as to common tree size.

It is not surprising that different writers have presented quite divergent accounts of forest conditions as they observed them. Environmental conditions vary greatly even within the geographic divisions used in this report. Consequently, at any given time in the past, two equally accurate observers reporting on forest conditions, for example in the Tanana River valley, might well appear to be in conflict yet each might be correct. A statement that is true for one locality may be false for another. Another reason for divergence in the accounts is that the concept of forest and timber differed with writers. Some evidently regarded all tree growth as "forest" or "timber" whereas others reserved at least the latter term for stands with trees large enough for sawlogs or cabin logs. Finally, as mentioned earlier, accounts of forest conditions based on what was seen along the banks of the larger rivers usually painted a brighter picture than that viewed by those who traveled back inland.

The altitude at which timber line occurred was reported to vary considerably but was most often placed between 2,000 and 3,000 feet. From earliest time, extensive areas in every geographic division were either treeless or bore only sparse stands of small, slowly growing black spruce. Agreement was quite general that the best forest, containing the largest and tallest trees, usually occurred along the larger streams and rivers. Poorly drained flats and gently rolling lowland areas, together with most north-facing slopes, usually represented unfavorable sites for tree growth. The earliest observers reported the existence of both recent and old burns.

White spruce was the dominant forest tree throughout most of interior Alaska. In favored locations, as along streams, occasional trees attained maximum diameters of around 36 inches and heights of at least 100 feet, but trees of this size were definitely the exception and not the rule. The amount of accessible spruce timber having sufficient size for use as sawlogs and building logs was limited even when Fort Yukon was built on the upper Yukon in 1847 and when Fort Gibbon was established near the mouth of the Tanana in 1900. In 1910 logs for the sawmills in Fairbanks were being driven 75 to 100 miles from the Chena and Salcha Rivers.

Paper birch and quaking aspen were commonly found on well drained upland situations but did not attain the size reached by white spruce. Black spruce was abundant on the cold, poorly drained sites but seldom attained a diameter of more than 8 or 9 inches and height of 30 to 40 feet. Balsam poplar was a common tree on islands in the larger rivers and on flood-plain alluvium. This tree probably attained greater size than any other in the Alaska interior, very occasionally reaching 6 feet diameter in the Susitna River valley. Larch never was a common tree and rarely reached a diameter of as much as 8 inches.

The principal difference between the contemporary forests of interior Alaska and the forests as observed by the earliest explorers and travelers may be that considerable of the larger-sized, more accessible white spruce has been cut and that more of the country now bears stands less than 60 years of age, or is treeless, as a result of repeated fires. The effect of the increase in forest fires around the turn of the century has not only brought about a change in the age classes represented in the forest, but has also increased the paper birch and quaking aspen at the expense of the white spruce.

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